Final Report

Geotechnical Analysis for Gluek Park Minneapolis, Minnesota

Prepared for the

U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604

Prepared by:

Earth Tech, Inc.
3033 Campus Drive North, Suite 290
Minneapolis, Minnesota 55441

June 2004

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

Appendix

EXECUTIVE SUMMARY

Granular fill soils contaminated with asbestos containing material (ACM) exist at Gluek Park and extend into the adjacent streambank. Based on site reconnaissance the streambank in this area is approximately 30 feet high with slopes ranging from 30 to 50 degrees. The 30-foot high streambank was noted during the reconnaissance as being unstable, with indications of severe scour and erosion damage from the Mississippi River floodwaters. Numerous slope failures and or sloughs were also noted as a result of the scour/erosion damage. This is exacerbated by the relatively steep slopes.

A total of eight soil borings were drilled and sampled near the top of the streambank for the purpose of defining soil conditions for slope stability analyses. The borings were extended to depths ranging from 30 to 50 feet. Laboratory tests were performed on select samples to better estimate the material properties and to verify soil types that were visually determined during field sampling. Elevation data collected on the slopes at eight cross sectional locations, in combination with the soil data, were used to generate eight soil profiles. These profiles were analyzed for stability for both the existing conditions, as well as possible conditions that could exist following or during remediation of the contaminated soils that exist along the streambank. It should be noted that contaminated soils were noted up to a maximum depth of 20 feet during completion of the borings.

It is concluded based on the existing conditions and slope stability analyses that the current slopes are unstable and likely to regress (or slough) under present conditions (which includes a vegetative support layer). Therefore, any remedial measure aimed at addressing the contaminated soil "in-place" should consider the potential long-term instability of these existing slopes and, thus, the effectiveness of the remedial measure.

Stability analyses were also performed on existing soil profiles, but without inclusion of the vegetative support layer. The results indicate the existing vegetation is providing an important stabilizing effect on the slopes. It is concluded that remediation of contaminated soils by partial removal and subsequent covering with a layer of clean soil will be difficult without removing or greatly disturbing the fairly extensive vegetative cover that currently exists on the slopes. The results clearly indicate that without the existing vegetation in place, even for a short time, slope failures or sloughing would occur at an accelerated rate. Additional slope instability could potentially create a short-term and long-term physical hazard, in addition to risking re-exposure of "covered" contaminated soils as a result of continued slope failures or sloughing.

Cutting the slopes back to a more stable configuration would be a fairly straightforward solution, but could also result in more contaminated soil being removed from the site. A stability analysis on a cutback slope angle of 2H:1V (i.e., 2-ft horizontal for every 1ft-vertical) indicates the reconfigured slope would be borderline stable at this angle. To ensure slope stability, the reconfiguration would require the slope to be cutback to an angle of approximately 2.5H:1V. This would result in a slightly "flatter" slope than one at 2H:1V, but would require more excavation in order to achieve it.

One option that would minimize the amount of soil that needs to be removed from the slope entails ballasting the toe with riprap. The riprap would be placed to a height of approximately 10 to 12 feet, and then the existing slope cutback starting at the top of the riprap could be set at an angle of approximately 2.3H:1V. The riprap would have the added benefit of providing the needed protection against erosion and scour during higher river conditions. A stability analysis on this potential reconfiguration indicates a long-term stable configuration.

1. INTRODUCTION

1.1 General

Waste vermiculite was used in the past to fill portions of Minneapolis' Gluek Park. The vermiculite has been found to contain a form of asbestos called tremolite. Based on the Emergency Response Plan (ERP) for this site, the top 6 inches of soil containing observable vermiculite shall be excavated and disposed off-site at a facility that is licensed to accept asbestos-containing materials (ACM). If vermiculite is observed after six inches, up to an additional 12 inches of soil will be excavated. Following removal of these soils, the excavations shall be restored to original grades using clean fill material, thus covering or isolating any remaining vermiculite and/or soils contaminated with ACM.

A critical feature of the remedial measure involves approximately 550 lineal feet of streambank along the Mississippi River. The streambank slopes are approximately 30 feet high and relatively steep. Existing vegetation on the banks/slopes is currently providing some level of stability, though visual observations indicate the banks have had both recent and past slope failures. In addition, the lower parts of the banks have scour damage from high water conditions of the river. Significant portions of the banks are composed of fill material containing vermiculite.

As indicated above, the existing slopes are relatively unstable. The removal of vegetation and excavation of soil from the banks during a remedial effort will undoubtedly exacerbate the problem. Further slope instability could potentially create a short-term and long-term physical hazard, in addition to risking re-exposure of "covered" contaminated soils as result of a slope failure or slough.

1.2 Purpose and Objective

Earth Tech has performed slope stability analyses on the subject streambank to determine the level or degree at which the existing slopes are unstable, as well as the potential impacts of removing existing vegetation and/or disturbing near surface soils during a remedial effort. Additionally, preliminary slope reconfiguration options were analyzed so that finished slopes could be both stable and compatible with the ERP.

1.3 Site Background

Gluek Park is located at 1926 Marshall Street Northeast in Minneapolis, Minnesota. It encompasses approximately 2.6 acres, including 550 lineal feet along the Mississippi River, as illustrated in Figure 1. The park location was previously the site of a brewery, which has since been demolished and removed from the site. It is believed that contaminated soils were brought to the site to fill low areas sometime after the brewery was demolished. The fill materials originated from nearby Western Mineral Products plant and are contaminated with Tremolite asbestos. Based on information such as the soil borings, partially buried trees and anecdotal information from nearby residents, as much as 20 feet of fill materials were placed at the site.

2. SCOPE OF WORK

In completing this geotechnical analysis report Earth Tech performed the following specific scope of work:

- Surveyed and developed eight cross-sections along the bank.
- Inspected and evaluated the condition of the existing streambank.
- Drilled and sampled eight soil borings along the top of the bank to final depths ranging from 30 to 50 feet.
- Performed field and geotechnical laboratory testing on collect soil samples.
- Evaluated the encountered subsurface conditions relative to slope stability.
- Developed a generalized soil profile at each cross-section location.
- Determined or estimated engineering soil parameters as applicable for slope stability analyses.
- Performed a slope stability analysis for each profile under existing conditions.
- Performed a slope stability analysis for each for the existing profile without vegetation.
- Developed three preliminary slope reconfiguration options.
- Analyzed each of the three slope reconfigurations for mass stability.
- Evaluated and addressed issues related to erosion and scour.
- Summarized conclusions and recommendations.

3. EXISTING SLOPE CONDITIONS

Based on site reconnaissance the streambanks along Gluek Park are approximately 30 feet high with slopes ranging from 30 to 50 degrees. The slope angles are often compounded, with the steeper portion in the lower or bottom one-third. A relatively flat area normally exists between the toe of the slopes and the river or waterline. This flat area is on the order of 10 feet wide and contains river sediments, such as sand, gravel, and cobbles.

The 30-foot high streambank was found to have moderate scour and erosion damage along the toe of slope from Mississippi River floodwaters. Unstable bank conditions observed included the following:

- Undercutting of the streambank by floodwaters along the entire length of Gluek Park with the damage from the undercutting appearing to extend vertically approximately 10 feet, which coincides with the height of the 100-year flood.
- Trees have been undercut; most of which have their root mass exposed or are fallen over.
- Isolated spots/or areas near the toe are standing at nearly a vertical angle due to a recent or past slope failure or the falling over of a significantly sized tree.
- Mass wasting along the bottom of the bank at some points where the undercut banks had sloughed.
- Washout of the park dock.

It is relatively obvious that the slopes are regressing because of scour and erosion, as well as the steepness that the fill soils were placed. Other noteworthy observation while performing the site reconnaissance include the following:

- The surface consists of brown to reddish brown sandy loam soils with numerous small trees and patches of grass.
- In general, the surface of the streambank is uneven with frequent erosion gullies and channels, as well as evidence of past and recent slope failures (or sloughs). The surface also contains trash, rubble, and boulders.
- The slopes contain numerous trees, which appear to be Box Elder and Cottonwood and are typically less than 12 inches in diameter. It is estimated that the average tree diameter is less than six inches. Larger trees that are located in the lower half of the slope tend to lean toward the river, often exposing part of their root system.
- Several pipes (concrete and steel corrugate steel) are protruding from the slope, though not draining water.
- In the northern portion of the site there is a stairway that leads to the river. There is also a flattened area adjacent to the stairway, approximately mid-slope. The flattened area has been stabilized with driven timber piles.

4. SUBSURFACE EXPLORATION

4.1 Field Procedures

A total of eight soil borings were drilled and sampled for this project by Bergerson and Caswell (Maple Plain, Minnesota). The borings were drilled at or near locations that were field staked by Earth Tech. The eight locations are generally evenly spaced along the 550-foot lineal length of the subject bank at Gluek Park, as illustrated on Figure 1.

The borings were extended to depths ranging from 30 to 50 feet with a two-man crew using a truck-mounted CME-75 drill rig. Drilling at each location was initially conducted using Level C protection until the on-site Field Safety Officer from Earth Tech allowed a downgrade to a modified Level C (without respirator) based on a lack of visual evidence that the vermiculite was present. If vermiculite was present or noted, drilling and sampling was conducted in Level C, and the soil cuttings from the boring were damped to minimize the potential for ACM particulates to become airborne.

The borehole was sampled using Standard Penetration Testing (SPT) inside 3¼ inch inside diameter (ID) hollow-stem augers. The augers served as casings as the borehole was advanced and prevented the borehole from caving. Drilling and field sampling were performed according to the following standard specifications.

> Sampling with a 2-inch O.D. split-barrel (split-spoon) sampler per ASTM D1586, *Standard Penetration Test and Split-Barrel Sample of Soils*. A wire-winched hammer was used to advance the sampler into the soil.

The number of hammer blows required to advance the split-spoon sampler 12 inches is referred to as the N-value. N-values were used to estimate the relative density of granular type soils and the consistency of cohesive type soils.

A field log was prepared for each boring during exploration, which included sample depths, soil type, relative moisture or presence of water, soil texture, and blowcounts. Once logged, the samples were sealed in containers to prevent loss of moisture, and transported to a soils lab (STS Consultants, Maple Grove, Minnesota) for further classification and testing. Information obtained on the samples was used to develop final boring logs, which are provided in Appendix A.

Upon completion, the borings were backfilled with a bentonite grout, in accordance with State of Minnesota regulations.

4.2 Laboratory Testing

To further classify the recovered sample and to further determine their engineering properties, the following soil tests were preformed by STS Consultants:

Visual Classification (ASTM D 2487)	29
Moisture Content (ASTM D 2216)	29
Gradation Analysis (ASTM C 136)	8
Percent Fines (ASTM D 1140)	16

The test results are provided in Appendix A, and discussed in Section 4.3 - Subsurface Conditions.

4.3 Subsurface Conditions

The soil profile encountered within the depth of exploration consisted of 13.0 to 20.0 feet of uncontrolled granular silty fill of variable composition. The underlain native soils consist of sand with gravel that generally transitions into a stratum of grayish colored finer-grained soil near the boring termination depths. The following is a summary of the characteristics of each of the soil strata as encountered in the soil borings.

Fill

As indicated above, fill soils were encountered at all eight boring locations (SB1 through SB8). Near the surface, the fill soils tend to be influenced by vegetation growth and erosion, often having a sandy loaming texture. These slightly organic soils generally extended to a depth of less than 3 feet. Beyond the vegetative root zone the fill materials range from brown silty sand (SM) to sandy silt (ML) with variable amounts of gravel, cobbles, and boulders.

The blowcounts, color, as well as the texture of the soils samples collected from the fill were variable. This variation in materials chacteristics is an indication the fill was not placed in a controlled manner (i.e., not compacted lifts). Based on the blowcounts, the fill soils are generally of a medium density, but the presence of many gravel, cobbles, and boulders did in multiple instances artificially increase the sampling resistance (i.e., blowcounts). The fill soils are generally damp to moist.

Based on field/sample interpretations, the thickness of the fill ranged from 13.0 feet in borings SB7 and SB8 to 20.0 feet in boring SB1. However, it should be noted that interpretations were difficult at times since the underlying native material was not always significantly different, nor was there a striking color change between the fill and underlying native soil.

Native Sand with Gravel

The native soils that were encountered below the fill consisted of a brown, damp to wet sand with variable amounts of gravel. Based on visual interpretation and lab testing, these native soils are predominately classified as Poorly Graded Sand with Gravel (SP). Cobbles and boulders were also encountered within this stratum, which is consistent with a river depositional environment. Based on the sampling blowcounts, the density of these granular soils is predominately medium dense to dense. The water table was noted with in this stratum at depths ranging from 28.0 feet to 30.5 feet. Based on the boring elevations (provided on the borings logs), the water table is estimated at elevation 799 feet (NGVD), which is approximately equal to the river level present at the time the borings were completed.

Fine Grained Soils

Seven of the eight soil boring encountered either wet silt to sandy silt (ML), clayey sand (SC), and silty/lean clay (CL-ML, CL) near the termination depths, or more specifically between depths 33.5 feet and 40.5 feet. The grayish color indicates unoxidized conditions usually located below the water table. Blowcounts within the more cohesive (or clayey) soils show a medium to stiff consistency, and the silty soils are loose to medium dense. Boring SB2, which extended to the greatest depth encountered gray stiff lean clay (CL) from approximately 40.0 feet to the boring termination depth of 50.0 feet.

4.4 Soil Parameters for Stability Analyses

Certain soil engineering properties are required for slope stability calculations. These include the unit weight of the soil (γ) and shear strength parameters. The shear strength parameters that are typically used in the calculation include the internal angle of friction (φ) for drained soils (e.g., sands, gravels, or consolidated clays), and the cohesion intercept (C) for undrained soils (such as unconsolidated clayey silt and clay). The internal friction angle for granular soils is similar to the steepest angle the soil would prefer to be placed or stand. All three engineering properties can be estimated based on factors such as soil type, density or consistency, knowledge of the depositional environment, moisture content, and grain size characteristics. The following is a discussion of the engineering properties used in the slope stability calculations.

Surfical Soils (3 feet)

The surfical fill soils on the bank are predominately a sandy loam. These near the surface soils are assumed to be loose due to frost action, erosion/deposition, and root penetration. Based on loose sand, the estimated unit weight (γ) and friction angle (φ) of the near surface soils are 115 pounds per cubic foot (pcf) and 27 degrees, respectfully.

Though these soils have little or no cohesion, the vegetation root systems are acting in manner that strengthens or provides reinforcement within the root zone. A rather modest cohesion value of 150 pound per square foot (psf) is estimated to reflect the internal shear strength the root systems are providing.

Fill

The underlying fill material is predominately a medium dense silty sand and sandy silt. For a medium dense soil of this type, the internal friction angle typically ranges from 28 degrees to 33 degrees. A low-end friction angle of 29 degrees is estimated and used in the stability analyses based in part on the variable and uncontrolled placement of the fill. Similarly, the estimated unit weight of the fill is 115 pcf. The granular fill material has no appreciable cohesion.

Native Sand with Gravel

The native sand with gravel is poorly graded with a trace to little amounts of silt. Based on the blowcounts the density of this material is typically medium dense. Given the soil type and density, the internal angle of friction would normally range from 30 degrees to 35 degrees. A value of 32 degrees is estimated and used for the slope stability analyses. The estimated unit weight is 125 pcf, which is also based on the soil type and density.

Fine Grained Soils

The soils that underlie the native sand and gravel are fine grained, including sandy silt, clayey sand and lean clay. The non-cohesive silty soils are assumed to have similar properties as the native sand and gravel discussed above. The more cohesive soils e.g., lean clay and clayey sand have a medium to stiff consistency. Based on the consistency, the cohesive fine-grained soils have an assumed cohesion intercept of 1,000 psf with no appreciable internal friction angle (i.e., undrained). The unit weight of the saturated clayey soils is estimated to be 132 pcf.

5. SLOPE STABILITY ANALYSES

5.1 Procedures and Methodology

Slope stability calculations were performed for the existing slopes and several reconfiguration options using the computer program UXTEXAS3. The program was developed for the Army Corp of Engineers by Stephen Wright of the University of Texas. The program allows the user to input a slope profile, material properties for each soil unit, water table elevation, and mode of possible failure (typically circular).

A total of eight cross sections were generated at locations indicated on Figure 1. The soil boring data was then used to develop soil profiles for each of the cross-sections, which are provided in Appendix B (Profiles Nos. 1 through 8).

The engineering properties discussed in the previous section were used as the material properties input data. The stability calculations were performed on these eight profiles, which are provided in Appendix B. A typical or generalized profile also provided on Figure 2. The most critical, or least stable profile (Profile No. 7) was further evaluated for stability for several reconfiguration options.

After several trial runs, it was determined that the exact depth or occurrence of the fine-grained soils that lie under the native sand is of no consequence to the results. Therefore, for simplicity, a medium-strength cohesive layer was assumed to be at a uniform elevation of 788 feet across the site, which is approximately 40 feet below the top of the bank.

5.2 Stability of Existing Slopes

5.2.1 Existing Vegetation

The eight profiles were analyzed for the existing conditions. In these analyses, a vegetation layer was assumed to a depth of 3 feet to model the reinforcement effects the vegetation is having of the stability of the slope. Based on the results, the computed factor of safety against failure for the eight profiles ranged from 0.98 to 1.73. The results are graphically depicted on the profiles provided in Appendix B.

Generally, a factor of safety less than 1.0 indicates imminent failure, whereas a factor of safety of 1.30 is considered the minimum acceptable value for design purposes, although under short-term conditions a factor of safety of less than 1.30 may be considered acceptable. Of the eight profiles analyzed, four of them (Nos. 2, 5, 6, and 7) had computed factors of safety less than 1.30. Of these four, two of the profiles (Nos. 2 and 7) have factors of safety less than 1.20. These results are consistent with the field observation that the slopes of the bank are relatively unstable and likely to continue to regress as a function of time, rainfall/erosion and scour.

5.2.2 Vegetation Removed

The same eight profiles were re-analyzed assuming no vegetation support. One of the methods for remediation being considered is the removal of 6 to 18 inches of soil and placement of the same thickness of clean fill. Because existing vegetation practically covers the slope it would be necessary, at least from a practical standpoint, to remove/or greatly disturb the vegetation during the remedial effort. Also, from a practical standpoint, it would also be very difficult to place a thin layer of clean fill on the rather steep slopes and expect it to "stick" without first removing the existing vegetation and scarifying the subgrade/soil so that the clean fill could effectively bond/interface with the "left in place" soils.

The removal of vegetation was simulated by reducing the cohesion intercept of the vegetation zone soils from 150 psf to 15 psf. All other parameters remained constant. The results indicate factors of safety between 0.66 and 1.47. Of the eight profiles analyzed, five of them (Nos. 2, 4, 5, 6, and 7) had computed factors of safety (against failure) less than 1.0, suggesting imminent failure at these particular cross section locations. Another two profiles (Nos.1 and 8) had computed factors of safety less than 1.10. The results clearly indicate the positive effects that the vegetation is having on the slopes, which are already borderline stable with the vegetation.

5.3 Potential Design Reconfigurations

Based on the above results, the slopes on the streambanks along Gluek Park will need to be stabilized as part of the soil remediation effort/design. One obvious option is to cutback the slope angle to a more stable configuration. However, a significant negative impact associated with cutting back the slope to achieve stability is that excavation would extend deeper and/or further into areas that contain vermiculite, thereby increasing the amount of ACM that would need to be disposed of off-site. Ballasting the toe area with weight (e.g., riprap) would have a positive impact on the stability of the slope and thus reduce the amount of vermiculite and/or ACM-contaminated soil that may need to be removed/cut from the streambanks. To weigh these impacts, several options were evaluated below using soil Profile No. 7, which based on the above analyses is the least stable of the eight profiles.

5.3.1 Uniform 2.0H:1V Angle

Slope profile was cutback to a 2.0H:1V angle and analyzed for stability. A 2-foot vegetation zone was used to simulate at least a minimal amount of soil reinforcement that would occur near the surface soils. But unlike the existing condition, the assumed cohesion for the surfical soils was reduced to 75 psf since the vegetation would not be mature for several years. Otherwise using the same engineering properties as before the computed factor of safety for the 2H:1V reconfiguration is 1.29. A value of 1.29 is slightly below the acceptable minimum value of 1.3. Another consideration is short-term stability of the slopes during the development of the vegetative layer. Initially, without the support of any vegetation the near surface soils would need to stand/hold strictly by their internal angle of friction, which is estimated to be 27 degrees. Coincidently, the reconfigured slope angle is also approximately 27 degrees, so the short-term stability of the surfical soils (i.e., cover soil) would be very marginal and prone to sliding or sloughing during heavy rainfall events. A graphic depiction of this profile and the results is provided in Appendix C.

5.3.2 Uniform 2.5H:1V Angle

Slope Profile No. 7 was cutback to a 2.5H:1V angle and analyzed for stability. The same 2-foot vegetation zone was used as discussed above. At this particular angle the computed factor of safety is 1.59, which is above the minimal acceptable value 1.3. The reduced angle (21 degrees) also makes the surfical soil substantially more stable under short-term conditions (i.e., no vegetation), but the drawback is that more soil would need to be excavated from the slopes. A graphic depiction of reconfigured profile and the results is provided in Appendix C.

5.3.3 2.3H:1V Angle with Riprap Support

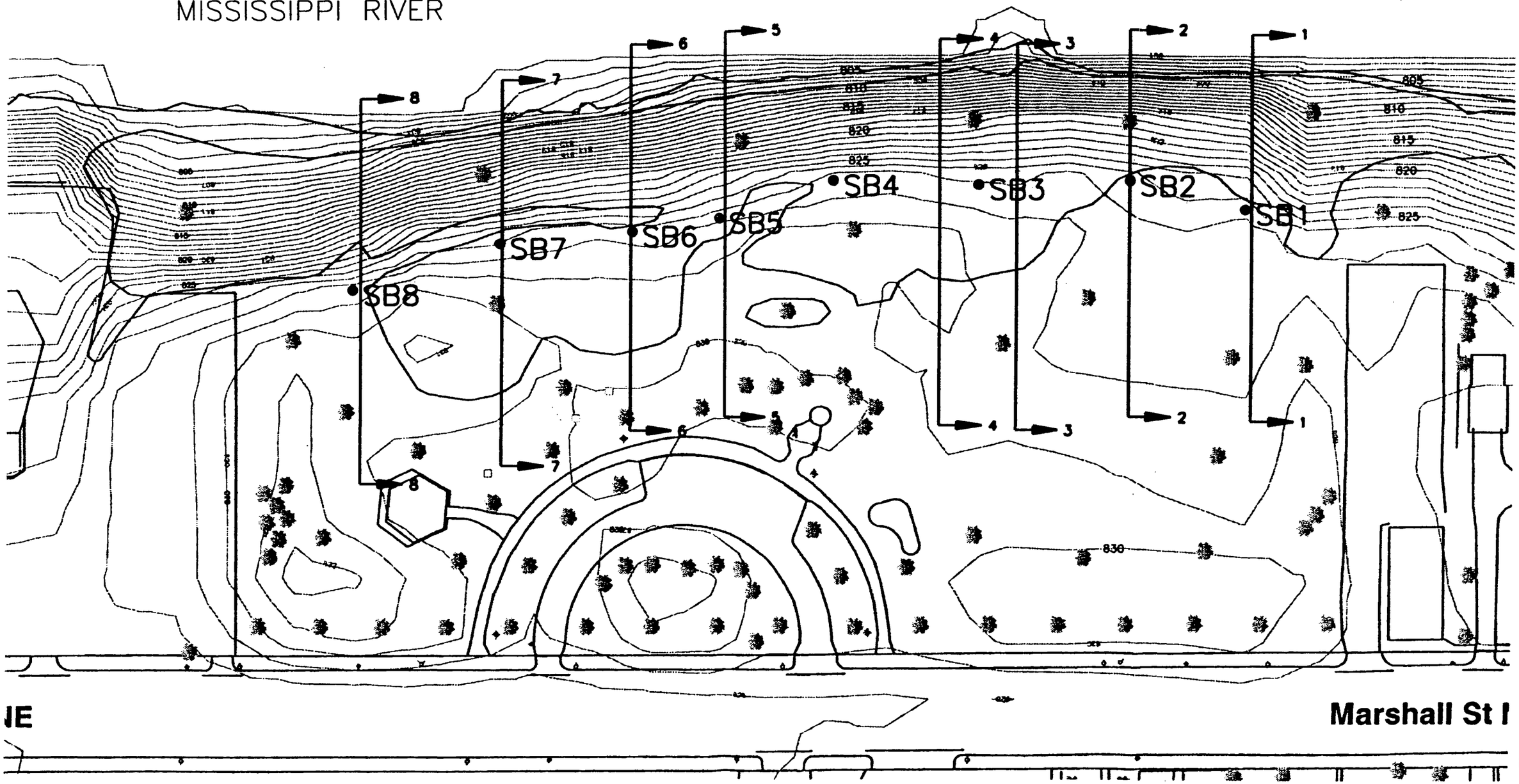
A third reconfirmation of Profile No. 7 was developed and analyzed for stability. This particular reconfiguration involves the placement of riprap at or near the water line and stacked at a 1.5H:1V angle to a height of 10 to 12 feet. The existing slope would then be regraded from the top of the riprap at a 2.3H:1V angle. The reconfigured profile was analyzed using the same engineering properties as discussed above. The result indicates a factor of safety against failure of 1.35, which is above the minimum acceptable value of 1.30. A 2.3H:1V angle equates to approximately 22 degrees, were as the estimated internal angle of friction of surface/cover soils is 27 degrees. This

difference suggests the soil would be reasonably stable, unless heavy rainfall and/or erosion events occurred prior to the development of a vegetative cover. In this case, erosion control matting would be prudent to assist the vegetation growth and to provide an added measure of safety against the cover soils from sliding.

FIGURE 1

Site Plan and Soil Boring Locations

MISSISSIPPI RIVER



JE

Marshall St I

LEGEND

● SB1 APPROX. SOIL BORING LOCATION

2 → 2 SLOPE PROFILE LINE

HORIZ. 0' 25' 50'

EARTH TECH

FIGURE 1
SITE PLAN AND
BORING LOCATIONS
GLUEK PARK
MINNEAPOLIS, MN

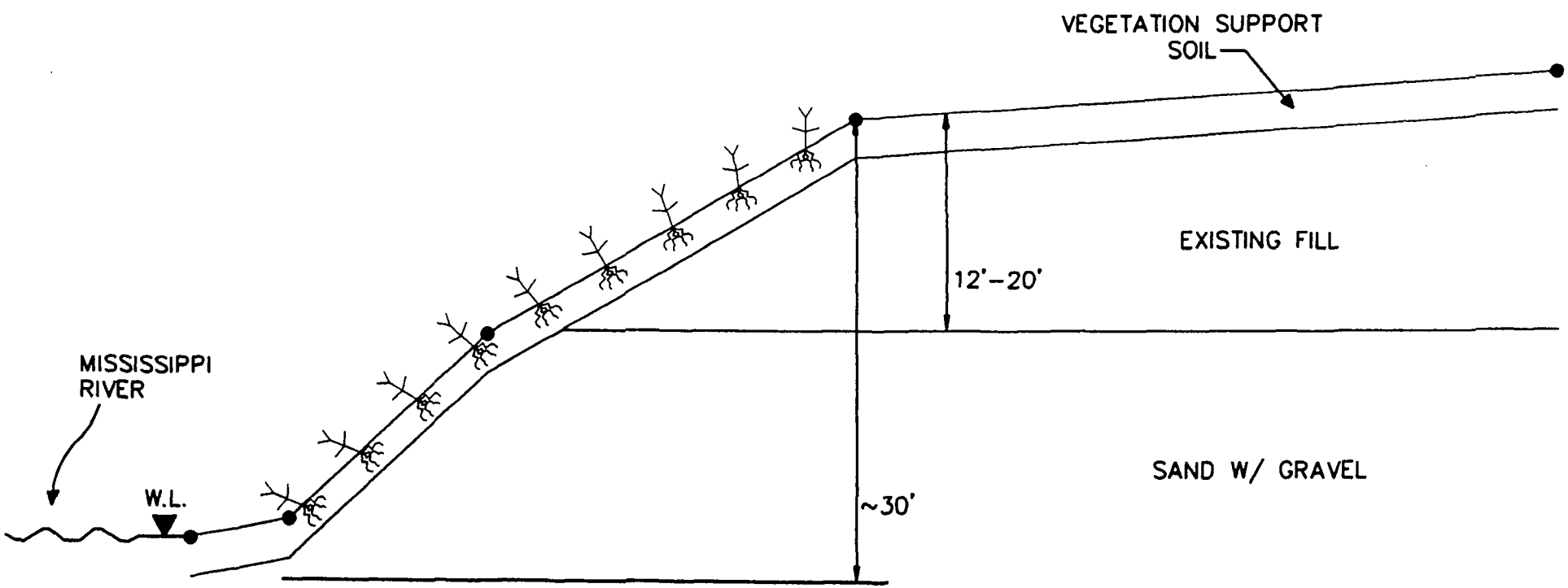
05/19/04

73040

FIGURE 2

Typical Existing Slope and Soil Profile

PRF = C:\TMP/\Profiles_NTB.prf
DATE =Thu Jun 03 10:57:10 2004
DGN =L:\work\73040\Cadd\Profiles_NTB.dwg
REFERENCE FILE 1 = L:\work\73040\Wat_Res\Survey\ACAD2000\Profiles_NTB.dwg
REFERENCE FILE 2 =
REFERENCE FILE 4 =



0' 5' 10' 20'

SCALE

EARTH TECH

FIGURE 2
TYPICAL EXISTING SLOPE AND SOIL PROFILE

GLUEK PARK
MINNEAPOLIS, MN

05/19/04

73040

FIGURE 3

Recommended Slope Reconfiguration

$$PRF$$
$$DATE$$
$$DWG$$

$$REF01$$
$$REF02$$

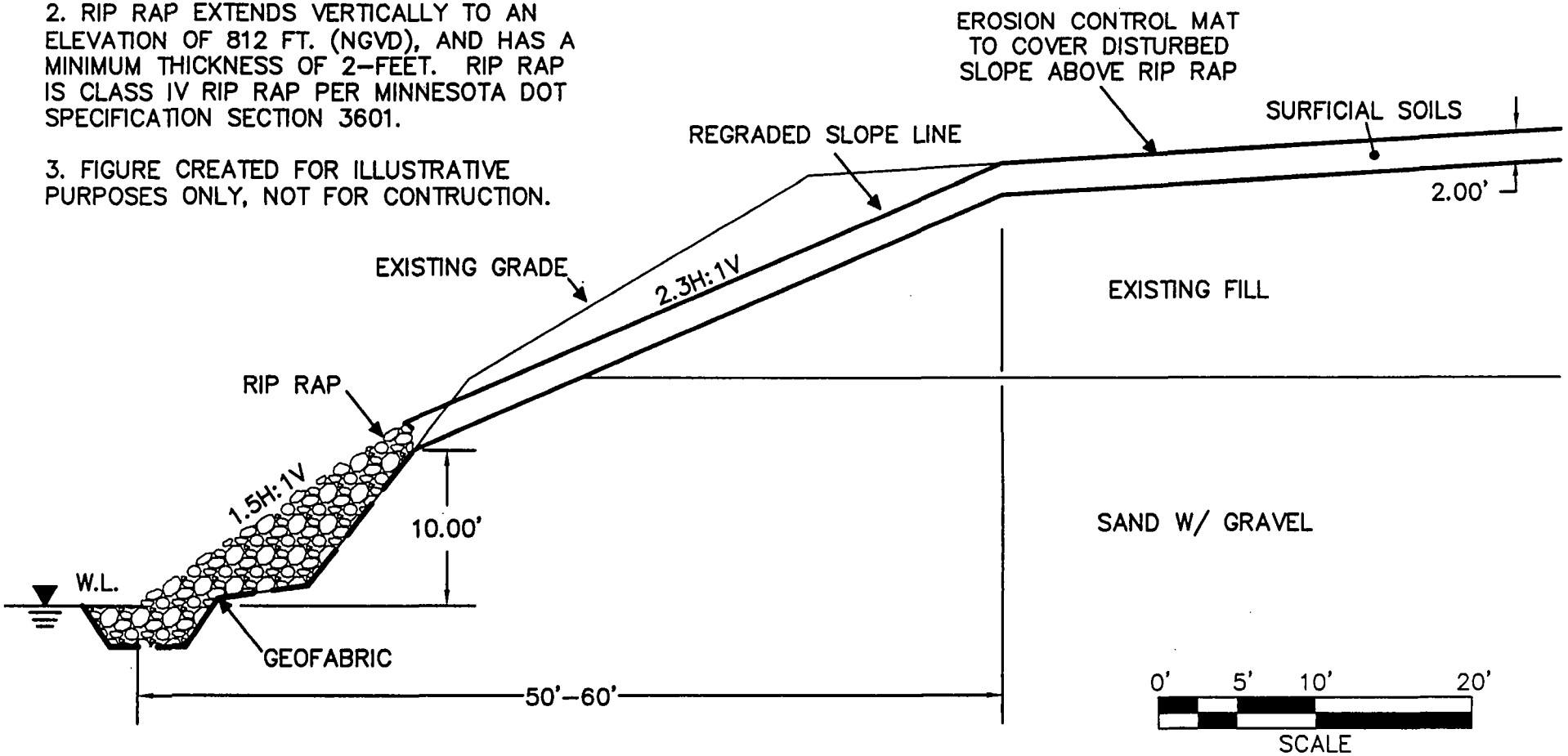
$$REF03$$
$$REF04$$

NOTES:

1. BASED ON BANK PROFILE NO.7

2. RIP RAP EXTENDS VERTICALLY TO AN ELEVATION OF 812 FT. (NGVD), AND HAS A MINIMUM THICKNESS OF 2-FEET. RIP RAP IS CLASS IV RIP RAP PER MINNESOTA DOT SPECIFICATION SECTION 3601.

3. FIGURE CREATED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONTRUCTION.



EARTH TECH

FIGURE 3
RECOMMENDED SLOPE RECONFIGURATION
GLUEK PARK
MINNEAPOLIS, MN

MAY 2004

73040

APPENDIX A

Subsurface Data

A-1 Soil Classification System

A-2 Boring Log Notes

A-3 Soil Boring Logs

A-4 Laboratory Test Data

APPENDIX A

Subsurface Data

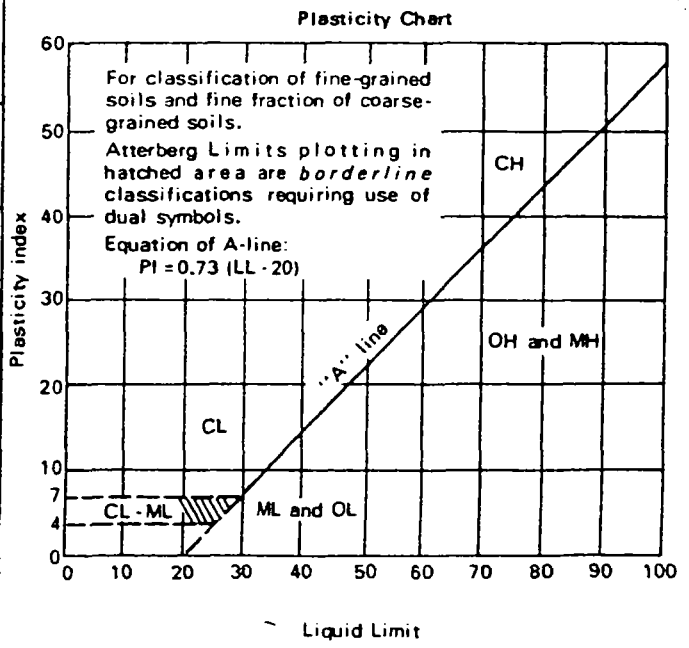
A-1 Soil Classification System

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 – 69 AND D 2488 – 69

(Unified Soil Classification System)

Major divisions			Group symbols	Typical names	Classification criteria		
Coarse-grained soils: More than 50% retained on No. 200 sieve*	Gravels: 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% pass No. 200 sieve . . . . . GW, GP, SW, SP; More than 12% pass No. 200 sieve . . . . . GM, GC, SM, SC; 5 to 12% pass No. 200 sieve . . . . . *Borderline* classifications requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are *borderline* classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands: More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are *borderline* classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils: 50% or more passes No. 200 sieve*	Silts and clays: Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays: Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt	Peat, muck and other highly organic soils			



*Based on the material passing the 3 in. (76 mm) sieve.

APPENDIX A

Subsurface Data

A-2 Boring Log Notes

GENERAL NOTES FOR BORING LOGS

Grain Size Terminology:

Soil Fraction		Particle Size	U.S. Sieve Size
Boulders		Larger Than 12"	Larger Than 12"
Cobbles		3" to 12"	3" to 12"
Gravel:	Coarse	¾" to 3"	¾" to 3"
	Fine	4.76mm to ¾"	#4 to ¾"
Sand:	Coarse	2.00mm to 4.76mm	#10 to #4
	Medium	0.42mm to 2.00mm	#40 to #10
	Fine	0.074mm to 0.42mm	#200 to #40
Fines		Less Than 0.074mm	Smaller than #200
Silt		0.005mm to 0.074	Smaller than #200
Clay		Smaller Than 0.005mm	

(Plasticity characteristics differentiate between silt and clay.)

Relative Proportions:

Term	Percentage by Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Relative Density (Cohesionless Soils):

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

The penetration resistance (blowcount), N, is the summation of the number of blows required to advance two successive 6" penetrations of the 2" split-barrel (spoon) sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration (ASTM D1586).

Consistency (Cohesive Soils):

Term	Unconfined Compressive Strength (tons/sq. ft.)	"N" Value
Very Soft	0.0 to 0.25	<2
Soft	0.25 to 0.50	2-4
Medium	0.50 to 1.0	4-8
Stiff	1.0 to 2.0	8-15
Very Stiff	2.0 to 4.0	15-30
Hard	Over 4.0	>30

Plasticity:

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High to Very High	Over 22

APPENDIX A

Subsurface Data

A-3 Soil Boring Logs

EARTH TECH

Boring No. SB-1

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 14, 2004
Project No. : 73040
Elevation: 827.5 feet (est)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		3	12	13				
		5				3.0		
		8					**FILL: brown, medium dense Silty Sand (SM) to Sandy Silt (ML), with Gravel and Boulders, fine to coarse grained, damp to moist**	
						4.0		
2		5	12	26		5.0		MC = 3.1%
		12						Fines = 22.2%
		14				6.0		
						7.0		
3		17	0	--			**...pounded on boulder**	
		22				8.0		
		29						
						9.0		
4		10	12	17		10.0	**...higher silt content, moist**	MC = 5.6%
		8						Fines = 51.5%
		9				11.0		
						12.0		
5		7	12	15			**...changing to dark brown/black**	
		7				13.0		
		8						
						14.0		
6		8	10	30		15.0		MC = 4.7%
		12						Gravel+ = 17.1%
		18				16.0		Fines = 16.5%
						17.0		
7		10	12	24				
		12				18.0		
		12						
						19.0		
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 28.0 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-1

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 14, 2004
Project No. : 73040
Elevation: 827.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		30	45				....pounded on possible cobble/boulder	
		22				24.0		
		23						
						25.0		
						26.0		
						27.0		
						28.0		
9		10	4	13			brown, medium dense Poorly Graded Sand (SP), fine to coarse grained, some gravel, trace to little silt, wet	MC = 15.2% Gravel+ = 13.8% Fines = 5.6%
		7				29.0		
		6						
						30.0		
						31.0		
						32.0		
						33.0		
10		4	18	16				
		7				34.0		
		9						
						35.0		
						36.0		
						37.0		
						38.0		
11		3	12	10			....medium dense/loose	
		4				39.0		
		6						
						40.0		
							END BORING @ 40.0 FEET	

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" Diameter Split-Spoon
DEPTH TO WATER: 28.0 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-2

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 14, 2004
Project No. : 73040
Elevation: 828.5 feet (est)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
6		25	0	--			.... pounded on boulder	
		32				24.0		
		28						
						25.0		
						26.0		
						27.0		
						28.0		
7		18	6	71			brown, medium dense Poorly Graded Sand (SP), fine to coarse grained, trace to little silt, trace to some gravel, few cobbles/boulders, moist to wet	
		33				29.0		
		38						
						30.0		
						31.0		
						32.0		
						33.0		
8		10	8	11				MC = 27.6%
		5				34.0		Gravel+ = 26.5%
		6						Fines = 9.8%
						35.0		
						36.0		
						37.0		
						38.0		
9		5	18	12				MC = 17.4%
		5				39.0		Fines = 5.6%
		7						
						40.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 29.5 ft (while drilling/sampling)
TERMINATION DEPTH: 50 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-2

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 14, 2004
Project No. : 73040
Elevation: 828.5 ft (est)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		2	14	7				
		3				3.0		
		4						
						4.0	**Fill: brown, loose to medium dense Sandy Silt (ML) to Silty Sand (SM), some Gravel and Rubble (wood, concrete), fine to coarse grained, damp to moist**	
2		13	12	19		5.0		
		14						
		5				6.0		
						7.0		
3		26	0	--			**.... pounded on concrete rubble (auger cuttings grayish sand)**	
		15				8.0		
		10						
						9.0		
						10.0		
						11.0		
						12.0		
						13.0		
4		15	6	17				MC = 1.1%
		9				14.0		Fines = 2.5%
		8						
						15.0		
							brown, medium dense Poorly Graded Sand (SP), fine to coarse grained, trace silt and gravel, damp to moist	
						16.0		
						17.0		
						18.0		
5		7	12	27				MC = 5.2 %
		12				19.0		
		15						
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 29.5 ft (while drilling/sampling)
TERMINATION DEPTH: 50 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. B-2

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 14, 2004
Project No. : 73040
Elevation: 828.5 feet (est)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						40.0		
						41.0		
10	AS					42.0		
						43.0	Gray LEAN CLAY (CL), wet	
						44.0		
						45.0		
						46.0		
						47.0		
						48.0		
						49.0		
						50.0	END BORING @ 50.0 FEET	
						51.0		
						52.0		
						53.0		
						54.0		
						55.0		
						56.0		
						57.0		
						58.0		
						59.0		
						60.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 29.5 ft (while drilling/sampling)
TERMINATION DEPTH: 50 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-3

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 15, 2004
Project No. : 73040
Elevation: 831.0 feet (est)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		4	14	7			**FILL: brown, loose to medium dense, Silty Sand (SM) and Sandy Silt (ML), some gravel, few boulders, damp to moist**	
		3				3.0		
		4						
						4.0		
2		8	12	21		5.0		
		10						
		11				6.0		
						7.0		
3		30	0	--			**....no sample recovery**	
		20				8.0		
		22						
						9.0		
4		2	0	--		10.0	**.... no sample recovery**	
		2						
		3				11.0		
						12.0		
5		11	12	80			**....pounded on boulder/cobble**	
		31				13.0		
		49						
						14.0		
6		22	3	48		15.0		
		24						
		24				16.0		
						17.0		
7		13	6	38				
		15				18.0	**brown, dense Poorly Graded Sand (SP) with Gravel, little silt, damp**	
		23						
						19.0		
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-3

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 15, 2004
Project No. : 73040
Elevation: 831.0 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		17	12	49			brown, dense Poorly Graded Sand (SP), little gravel, trace to little silt, damp to moist	MC = 2.0% Gravel+ = 11.8% Fines = 6.2%
		23				24.0		
		26						
						25.0		
						26.0		
						27.0		
						28.0		
9		12	12	37				MC = 4.4% Fines = 9.5%
		16				29.0		
		21						
						30.0	....encountered boulder while drilling	
						31.0		
						32.0		
						33.0		
10		15	24	18			....same except medium dense and wet	
		8				34.0		
		10						
						35.0		
						36.0		
						37.0		
						38.0		
11		3	6	11				MC = 24.1% Fines = 28.4%
		5				39.0	gray, medium dense/loose Silty Clayey Sand (SC), wet	
		6						
						40.0		
							END BORING @ 40.0 FEET	

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-4

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 15, 2004
Project No. : 73040
Elevation: 829.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		10	18	27			**FILL: brown, medium dense to dense Sandy Silt (ML) and Silty Sand (SM) with Gravel, few cobbles/boulders, damp to moist**	
		12				3.0		
		15						
						4.0		
2		7	15	28		5.0		
		12						
		16				6.0		
						7.0		
3		15	15	28				
		15				8.0		
		13						
						9.0		
4		5	15	23		10.0		
		10						
		13				11.0		
						12.0		
5		5	12	31				
		13				13.0		
		18						
						14.0		
6		19	18	38		15.0		
		23						
		15				16.0		
						17.0		
7		14	12	39			**brown, dense Poorly Graded Sand (SP), trace to little silt, trace gravel, damp to moist**	
		15				18.0		
		24						
						19.0		
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-4

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 15, 2004
Project No. : 73040
Elevation: 829.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		11	12	64				MC = 2.3%
		28				24.0	brown, very dense Poorly Graded Sand (SP), fine to medium grained, little silt, damp	
		36						
						25.0		
						26.0		
						27.0		
						28.0		
9		14	12	59			....moist	MC = 7.4%
		23				29.0		P200 = 6.2%
		36						
						30.0		
						31.0		
						32.0		
						33.0		
10		7	8	7			....loose, wet	
		4				34.0		
		3						
						35.0		
						36.0		
						37.0		
						38.0		
11		6	12	6			....increased fines	P200 = 31.8
		3				39.0		MC = 25.2%
		3			2.25		gray, stiff Sandy Lean Clay (CL), wet	
						40.0		
							END BORING @ 40.0 FEET	

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-5

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 16, 2004
Project No. : 73040
Elevation: 827.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		4	18	24			**FILL: brown, medium dense Silty Sand (SM) and Sandy Silt (ML), some gravel, few cobbles/boulders, trace organics, damp to moist**	
		7				3.0		
		17						
						4.0		
2		6	18	19		5.0		
		8						
		11				6.0		
						7.0		
3		11	12	29				
		15				8.0		
		14						
						9.0		
4		7	18	30		10.0		
		15						
		15				11.0		
						12.0		
5		12	18	46			**....very dense**	
		22				13.0		
		24						
						14.0		
6		30	0	--		15.0	**....no recovery, possible boulder/cobble**	
		39						
		37				16.0		
						17.0		
7		5	12	33				
		18				18.0		
		15					**brown, dense Poorly Graded Sand (SP), trace silt, damp to moist**	
						19.0		
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30.5 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-5

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 16, 2004
Project No. : 73040
Elevation: 827.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		26	1	--			....pounded on boulder/cobble	
		50/5				24.0		
		--						
						25.0		
						26.0		
						27.0		
						28.0		
9		5	18	58				MC = 9.9%
		26				29.0	brown, Poorly Graded Sand (SP) with	Gravel+ = 16.1%
		32					Gravel, trace to little silt, moist	Fines = 4.6%
						30.0		
						31.0		
						32.0		
						33.0		
10		3	4	11			....wet	MC = 29.8%
		5				34.0		Fines = 7.4%
		6						
						35.0		
						36.0		
						37.0		
						38.0		
11		6	2	16				
		8				39.0		
		8					gray, stiff Lean Clay (CL), moist/wet	
						40.0		
							END BORING @ 40.0 FEET	

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30.5 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-6

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 16, 2004
Project No. : 73040
Elevation: 827.0 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		12	18	41				
		20				3.0	**FILL: brown, medium dense Poorly Graded Sand (SP), Silty Sand (SM), and Sandy Silt (ML), some Gravel, damp to moist**	
		21						
						4.0		
2		7	18	15		5.0		
		7						
		8				6.0		
						7.0		
3		9	18	22				
		10				8.0		
		12						
						9.0		
4		9	18	18		10.0		MC = 6.7% Fines = 57.9%
		9						
		9				11.0		
						12.0		
5		18	8	51			**....changing to dense and very dense, possibly more gravel/cobbles**	
		23				13.0		
		28						
						14.0		
6		7	12	47		15.0		MC = 1.3% Gravel+ = 22.7% Fines = 6.8%
		23						
		24				16.0		
						17.0		
7		11	18	40				
		21				18.0		
		19						4" layer of Clayey Sand @ 18.5 feet
						19.0	**brown Poorly Graded Sand (SP) with Gravel, moist**	
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 28.5 ft (while drilling/sampling)
TERMINATION DEPTH: 35 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-6

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 16, 2004
Project No. : 73040
Elevation: 827.0 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		40	12	64			brown, Poorly Graded Sand (SP) with Gravel, trace silt, damp, pounded on boulder/cobble	MC = 1.7%
		31				24.0		
		33						
						25.0		
						26.0		
						27.0		
						28.0		
9		12	12	34			brown, medium dense to dense, Poorly Graded Sand with Gravel (SP), trace silt, moist to wet	MC = 12.9% Fines = 2.9%
		16				29.0		
		18						
						30.0		
						31.0		
						32.0		
						33.0		
10		10	3	8				
		4				34.0	dark grayish brown, loose/medium stiff Sandy Clayey Silt (ML-CL), wet	
		4						
						35.0		
						36.0	....auger refusal at 36.5 reet	
						37.0	End Boring @ 36.5 Feet	
						38.0		
						39.0		
						40.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 28.5 ft (while drilling/sampling)
TERMINATION DEPTH: 35 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-7

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 19, 2004
Project No. : 73040
Elevation: 828.0 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						0.0	Surface: Grass and Bare Ground/Top of Bank	
						1.0		
						2.0		
1		4	18	31				
		10				3.0		
		21						
						4.0	**FILL: dark brown to brown, medium dense Silty Sand (SM) and Sandy Silt (ML), damp to moist**	
2		4	18	17		5.0		
		8						
		9				6.0		
						7.0		
3		9	18	24				MC = 5.6%
		12				8.0		Fines = 36.6%
		12						
						9.0		
4		5	18	18		10.0		MC = 4.1%
		9						
		9				11.0		
						12.0		
5		3	18	13				
		5				13.0		
		8						
						14.0		
							brown, medium dense Poorly Graded Sand (SP) with Gravel (SP), trace to little silt, moist	
6		5	18	25		15.0		
		11						
		14				16.0		
						17.0		
7		16	12	72				MC = 1.8%
		36				18.0		Gravel+ = 47.0%
		36						Fines = 6.2%
						19.0		
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 29.5 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-7

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 19, 2004
Project No. : 73040
Elevation: 828.0 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	Ft. in.	Tr. N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		24	12	71				
		33				24.0		
		38					brown, medium dense Poorly Graded	
						25.0	Sand with Gravel, trace to little silt, moist	
						26.0		
						27.0		
						28.0		
9		17	12	18			....few small layers of clay, wet	
		10				29.0		
		8						
						30.0		
						31.0		
						32.0		
						33.0		
10		7	24	21			.... dark brown, wet	MC = 13.3%
		9				34.0		Fines = 10.9%
		12						
						35.0		
						36.0		
						37.0		
						38.0		
11		11	24	17			dark gray layers of stiff/loose Clayey	MC = 47.6%
		10				39.0	Sand (SC) and Sandy Silt (ML), wet	Fines = 29.6%
		7						
						40.0		
							END BORING @ 40.0 FEET	

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 29.5 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-8

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 19, 2004
Project No. : 73040
Elevation: 828.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6	R in.	N	PP	Depth (feet)		
						0.0	FILL: brown, loose to medium dense Sandy Silt (ML) to Silty Sand (SM), moist	concrete rubble noted at approx. 5 feet while drilling
						1.0		
						2.0		
1		2	18	5				
		2				3.0		
		3						
						4.0		
2		2	12	5		5.0		
		2						
		3				6.0		
						7.0		
3		4	18	15				MC = 8.6 Fines = 51.2%
		7				8.0		
		8						
						9.0		
4		4	8	13		10.0		
		7						
		6				11.0		
						12.0		
5		7	18	17				
		7				13.0		
		10					brown, medium dense Poorly Graded Sand with Gravel (SP), trace silt, damp	
						14.0		
6		12	12	28		15.0		MC = 1.4% Gravel+ = 41.3% Fines = 4.7%
		14						
		14				16.0		
						17.0		
7		12	18	66				MC = 2.4%
		31				18.0		
		35						
						19.0		
						20.0		

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

EARTH TECH

Boring No. SB-8

Client: EPA Region V
Project: Gluek Park
Location: Marshall Street, Minneapolis, MN

Date: April 19, 2004
Project No. : 73040
Elevation: 828.5 feet (est.)

Sample Information							Soil Description	Comments
No.	Type	Blows /6"	R in.	N	PP	Depth (feet)		
						20.0		
						21.0		
						22.0		
						23.0		
8		10	18	43			brown, medium dense Poorly Graded Sand with Gravel (SP), trace silt, moist to wet	
		21				24.0		
		22						
						25.0		
						26.0		
						27.0		
						28.0		
9		5	1	16				
		6				29.0		
		10						
						30.0	.....wet	
						31.0		
						32.0		
						33.0		
10		6	18	21				
		8				34.0		MC = 22.0%
		13						Fines = 72.2
						35.0	browish gray, medium dense/stiff Clayey Silt (ML-CL), few sand seams, wet	
						36.0		
						37.0		
						38.0		
11		25	0	--				
		33				39.0	....no recovery, pounded on possible boulder, Silt auger cuttings	
		35						
						40.0		
							END BORING @ 40.0 FEET	

DRILLED BY: Bergerson and Caswell
DRILL RIG: CME-75
DRILL METHOD: 3-1/4" (ID) Hollow Stem Augers
LOGGED BY: D.H.

SAMPLING METHOD: 2" diameter Split-Spoon
DEPTH TO WATER: 30 ft (while drilling/sampling)
TERMINATION DEPTH: 40 feet
ABANDONMENT METHOD: Grout

APPENDIX A

Subsurface Data

A-4 Laboratory Test Data

STS CONSULTANTS, LTD. TRANSMITTAL

10900 - 73rd Ave. N., Suite 150
Maple Grove, MN 55369-5547
763/315-6300 FAX 763/315-1836

To: Earth Tech, Inc.
3033 Campus Drive
Plymouth, MN 55441
Attn: Mr. Jerry Canfield
jerry.canfield@earthtech.com

Date: 4/30/04 **STS Project** 99482
Re: Western Materials – Gluek Park
Minneapolis, Minnesota

We are sending the following item(s):

	Boring Logs		Proposal/Report		Specifications
	Change Order		Repair Documents	X	Test Results
	Copy of Letter		Samples		Field Reports
	Plans		Shop Drawings		Other

Copies	Date	Number	Description
1	4/27/04		Summary of Analysis
	4/27/04		Gradation Analysis Test Analysis

Remarks

Copy to: Mr. Rollie Boehm – Earth Tech
Rollie.boehm@earthtech.com

Mr. Roger Clay – Earth Tech
Roger.clay@earthtech.com

STS Representative

Steven J. Ruesink, P.E.

D699482-1 temp.doc

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone:763/315-6300 Fax: 763-315-1836

Visual Classification ASTM D2488
P-200 ASTM C-117
Moisture (%) ASTM D2216

Project Name: Western Mineral - Gluek Park
STS Project No.: 99482
Location: Minneapolis, MN
Date: 27-Apr-04

Summary of Test Results

Boring / Sample	Depth	Classification	P200 (%) Fines	Moisture (%) As received
B-1;S-2	5-6.5'	Brown fine to coarse sand, little gravel, little silt (SM)	22.2	3.1
B-1;S-4	10-11.5'	Brown sandy silt, trace gravel - (SM)	51.5	5.6
B-1;S-6	15-16.5'	Brown fine to coarse sand with gravel, little silt - (SM)		4.7
B-1;S-9	28.5-30'	Brown fine to coarse sand with gravel, little silt - (SP-SM)		15.2
B-2;S-4	13.5-15'	Brown fine to coarse sand, trace silt, trace gravel - (SP)	2.5	1.1
B-2;S-5	18.5-20'	Brown fine to coarse sand, trace silt, trace gravel - (SP)		5.2
B-2;S-8	33.5-35'	Dark grayish brown fine to coarse sand, little silt, trace gravel (SP-SM)		27.6
B-2;S-9	38.5-40'	Brown fine to coarse sand, trace silt, trace gravel - (SP)	5.6	17.4
B-3;S-8	23.5-25'	Brown fine to coarse sand with gravel, trace silt - (SP-SM)		2
B-3;S-9	28.5-30'	Brown fine to coarse sand with gravel, trace silt - (SP-SM)	9.5	4.4
B-3;S-11	28.5-30'	Dark brown fine to coarse sand, some silt, little gravel - (SM)	28.4	24.1
B-4;S-8	23.5-25'	Brown fine to coarse sand, trace silt, trace gravel - (SP)		2.3
B-4;S-9	28.5-30'	Brown layers of fine to coarse sand, trace silt, trace gravel, trace clay - (SP-SM)	6.2	7.4
B-4;S-11	38.5-40'	Very dark grayish brown clayey silt, trace sand and gravel, organic traces (ML)	31.8	25.2
B-5;S-9	28.5-30'	Brown fine to coarse sand with gravel, trace silt - (SP)		9.9
B-5;S-10	33.5-35'	Dark brown fine to coarse sand, trace to little silt with gravel, trace fill (SP-SM)	7.4	29.8

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone:763/315-6300 Fax: 763-315-1836

Visual Classification ASTM D2488
P-200 ASTM C-117
Moisture (%) ASTM D2216

Project Name: Western Mineral - Gluek Park
STS Project No.: 99482
Location: Minneapolis, MN
Date: 27-Apr-04

Summary of Test Results

Boring / Sample	Depth	Classification	P200 (%) Fines	Moisture (%) As received
B-6;S-4	10-11.5'	Brown clayey silt, trace gravel, trace cinder(fill) - (SM)	57.9	6.7
B-6;S-6	15-16.5'	Brown fine to coarse sand with gravel, trace silt - (SP-SM)		1.3
B-6;S-8	23.5-25'	Brown fine to coarse sand, some gravel, trace silt - (SP)		1.7
B-6;S-9	28.5-30'	Brown fine to coarse sand, trace silt, trace gravel - (SP)	2.9	12.9
B-7;S-3	7.5-9'	Brown silty sand, trace gravel, trace fill - (SM)	36.6	5.6
B-7;S-4	10-11.5'	Brown silty sand with gravel, trace cinder (fill) - (SM)		4.1
B-7;S-7	17.5-19'	Brown fine to coarse sand with gravel, trace silt - (SP-SM)		1.8
B-7;S-10	33.5-35'	Dark brown layers of clayey silt and silty sand, organic traces - (ML-SC)	10.9	13.3
B-7;S-11	38.5-40'	Dark gray layers of clayey fine sand and silty sand - (SM)	29.6	47.6
B-8;S-3	7.5-9	Brown Sandy Silt - (ML)	51.2	8.6
B-8;S-6	15-16.5'	Brown fine to coarse sand, little gravel, trace silt - (SP)		1.4
B-8;S-7	17.5-19'	Brown fine to coarse sand, trace silt, trace gravel - (SP)		2.4
B-8;S-10	33.5-35'	Light brownish gray clayey silt, trace sand - (ML-CL)	72.2	22.0

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-1**
Sample: **S-6**

Classification/Description: Brown fine to coarse sand, little gravel, little silt - SM

Summary of Test Results

Sieve Size	Percent Passing
1"	100
3/4"	94.7
5/8"	90.9
3/8"	88.1
#4	82.9
#8	77.5
#10	75.9
#20	66.2
#40	42.9
#80	19.2
#200	16.5

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-1**
Sample: **S-9**

Classification/Description: Brown fine to coarse sand, with gravel, little silt (SP- SM)

Summary of Test Results

Sieve Size	Percent Passing
1"	
3/4"	
5/8"	100
3/8"	89.9
#4	86.2
#8	80.5
#10	78.5
#20	65.2
#40	37.3
#80	8.4
#200	5.6

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-2**
Sample: **S-8**

Classification/Description: Dark grayish brown fine to coarse sand, little silt, trace gravel - (SP-SM)

Summary of Test Results

Sieve Size	Percent Passing
1"	100
3/4"	95.5
5/8"	89.6
3/8"	81.7
#4	73.5
#8	64.1
#10	61.8
#20	49.3
#40	35.3
#80	17.8
#200	9.8

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-3**
Sample: **S-8**

Classification/Description: Brown fine to coarse sand with gravel, trace silt - (SP-SM)

Summary of Test Results

Sieve Size	Percent Passing
1"	
3/4"	
5/8"	100
3/8"	96.6
#4	88.2
#8	78.0
#10	75.5
#20	58.7
#40	33.9
#80	9.3
#200	6.2

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-5**
Sample: **S-9**

Classification/Description: Brown fine to coarse sand with gravel, trace silt - (SP)

Summary of Test Results

Sieve Size	Percent Passing
1"	
3/4"	
5/8"	96.3
3/8"	92.1
#4	83.9
#8	76.1
#10	74.3
#20	62.2
#40	38.8
#80	10.0
#200	4.6

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-6**
Sample: **S-6**

Classification/Description: Brown fine to coarse sand with gravel, trace silt - (SP-SM)

Summary of Test Results

Sieve Size	Percent Passing
1"	100
3/4"	95.1
5/8"	88.3
3/8"	86.1
#4	77.3
#8	67.4
#10	64.8
#20	48.6
#40	25.7
#80	10.0
#200	6.8

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-7**
Sample: **S-7**

Classification/Description: Brown fine to coarse sand with gravel, trace silt - (SP-SM)

Summary of Test Results

Sieve Size	Percent Passing
1"	100
3/4"	94.9
3/8"	76.3
#4	63.0
#8	48.7
#10	45.5
#20	30.1
#40	18.9
#80	9.7
#200	6.2

Sieve data

STS Consultants Ltd.
Consulting Engineers
Laboratory Services Group
10900 73rd Avenue, Suite 150 Maple Grove, MN 55369 Phone: 763/315-6300 Fax: 763-315-1836

GRADATION ANALYSIS
ASTM C136

STS Project No.: **99482**
Project Name: **Western Minerals - Gluek Park**
Location: **Minneapolis, MN**
Date: **April 27, 2004**
Boring **B-8**
Sample: **S-6**

Classification/Description: Brown fine to coarse sand, little gravel, trace silt - (SP)

Summary of Test Results

Sieve Size	Percent Passing
1"	100
3/4"	78.3
5/8"	76.8
3/8"	68
#4	58.7
#8	48.8
#10	46
#20	31.8
#40	18.5
#80	7.8
#200	4.7

Sieve data

APPENDIX B

Slope Stability Analyses – Existing Conditions

B-1 Typical Data File

B-2 Typical Output File

B-3 Graphic Presentation of Results

APPENDIX B

Slope Stability Analyses – Existing Conditions

B-1 Typical Data File

```
HEADING
 Gluek Park Remediation
 Profile #1 - Existing Slope with Vegetation
 May 20, 2004
PROFILE LINES
 1  1  Surface/Vegetated
-10.00    799.00
  0.00    799.77
 21.58    812.64
 49.09    827.27
 71.01    828.01
150.00    828.01

 2  2  Fill
  21.58   809.64
  49.09   824.27
  71.01   825.01
 150.00   828.01

 3  3  Top of Native Sand
-50.00    799.00
  0.00    796.77
 21.58    809.64
150.00    812.01

 4  4  Top of Native Clay
-50.00    788.00
  0.00    788.00
150.00    788.00


MATERIAL PROPERTIES
   1      VEGETATED SURFICAL SOILS
   115 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
    150   27
   NO PORE PRESSURE
   2      EXISTING FILL SOILS
   115 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
    0    29
   NO PORE PRESSUE
   3      NATIVE GRANULAR SOILS
   125 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   0     32
   PIEZOMETRIC LINE
    1
   4      NATIVE CLAY
   132 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   1000    0
   PIEZOMETRIC LINE
    1

   PIEZOMETERIC LINE DATA
   1     62.4    WATER TABLE
   -50   799
   150   799
```

```
ANALYSIS/COMPUTATIONS
   CIRCULAR    SEARCH
    50  855  2.0  0
    POINT
    0.00  799.77
    SUBTENDED
    6
    SHORT
    PROCEDURE
    SPENCER

COMPUTE
```

APPENDIX B

Slope Stability Analyses – Existing Conditions

B-2 Typical Output File

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat

TABLE NO. 1
```
*****************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.107                      *
* Last Revision Date 10/13/91            *
* (C) Copyright 1985-1991 S. G. Wright   *
* All Rights Reserved                    *
*****************************************
```

```
*****************************************************************
*                                                               *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER    *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY     *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL      *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE      *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER     *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS         *
* PROGRAM BEFORE ATTEMPTING ITS USE.                            *
*                                                               *
*      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT    *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR     *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS     *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                     *
*                                                               *
*****************************************************************
```

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 2
```
**************************
* NEW PROFILE LINE DATA *
**************************
```

PROFILE LINE 1 - MATERIAL TYPE = 1
Surface/Vegetated

Point	X	Y
1	-10.000	799.000
2	.000	799.770
3	21.580	812.640
4	49.090	827.270
5	71.010	828.010
6	150.000	828.010

PROFILE LINE 2 - MATERIAL TYPE = 2
Fill

Point	X	Y
1	21.580	809.640
2	49.090	824.270
3	71.010	825.010
4	150.000	828.010

PROFILE LINE 3 - MATERIAL TYPE = 3
Top of Native Sand

Point	X	Y
1	-50.000	799.000
2	.000	796.770
3	21.580	809.640
4	150.000	812.010

PROFILE LINE 4 - MATERIAL TYPE = 4
Top of Native Clay

Point	X	Y
1	-50.000	788.000
2	.000	788.000
3	150.000	788.000

All new profile lines defined - No old lines retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 3
****
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

DATA FOR MATERIAL TYPE 1
VEGETATED SURFICAL SOILS

Unit weight of material = 115.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 150.000
Friction angle - - - - - 27.000 degrees

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 2
EXISTING FILL SOILS

Unit weight of material = 115.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - .000
Friction angle - - - - - 29.000 degrees

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 3
NATIVE GRANULAR SOILS

Unit weight of material = 125.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - .000
Friction angle - - - - - 32.000 degrees

Pore water pressures defined by piezometric line

Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
NATIVE CLAY

Unit weight of material = 132.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 1000.000
Friction angle - - - - - .000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y	
1 - Unit weight of water =		62.40		WATER TABLE
1	1	-50.000	799.000	WATER TABLE
1	2	150.000	799.000	WATER TABLE

All new piezometric lines defined - No old lines retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 50.000
Y = 855.000

Required accuracy for critical center (= minimum spacing between grid points) = 2.000

Critical shear surface not allowed to pass below Y = .000

For the initial mode of search
all circles pass through the point at -
X = .000

Y = 799.770

Maximum subtended angle to be used for subdivision of the circle into slices = 6.00 degrees

Short form of output will be used for search

Procedure used to compute the factor of safety: SPENCER

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination for Spencer's procedure) will be kept constant during search

Depth of crack = .000

Search will be continued to locate a more critical shear surface (if one exists) after the initial mode is complete

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-50.000	799.000
2	-10.000	799.000
3	.000	799.770
4	21.580	812.640
5	49.090	827.270
6	71.010	828.010

7 150.000 828.010

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 20

Mode	Center Coordinates of Critical Circle X	Y	Radius	1-Stage Factor of Safety	Side Force Inclin.
1 Fixed Point at X = .0, Y = 799.8	-20.000	903.000	105.150	1.301	24.78
2 Tangent Line at Y = 797.9	-20.000	903.000	105.150	1.301	24.78

TABLE NO. 21
***** 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center	-20.000
Y Coordinate of Center	903.000
Radius	105.150
Factor of Safety	1.301
Side Force Inclination	24.78
Number of circles tried	78
No. of circles F calc. for	46

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 26
* Coordinate, Weight, Strength and Pore Water Pressure Information for Individual Slices for Conventional Computations or First Stage of Multi-Stage Computations. (Information is for the Critical Shear Surface in the Case of an Automatic Search.) *

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	.0	799.8					
1	4.2	800.8	1437.4	1	150.00	27.00	.0
	8.3	801.7					
2	13.5	803.5	5360.5	3	.00	32.00	.0
	18.8	805.3					
3	20.2	805.8	2015.3	3	.00	32.00	.0
	21.6	806.4					

4	25.1	808.1	5315.2	3	.00	32.00	.0
	28.6	809.8					
5	33.4	812.6	6912.5	2	.00	29.00	.0
	38.1	815.4					
6	42.5	818.6	5225.8	2	.00	29.00	.0
	46.9	821.9					
7	48.0	822.8	954.3	2	.00	29.00	.0
	49.1	823.7					
8	49.4	824.0	238.1	2	.00	29.00	.0
	49.7	824.3					
9	51.4	825.8	580.3	1	150.00	27.00	.0
	53.1	827.4					

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO SURFACE PRESSURES Normal Force	Shear Force	X	Y
1	4.2	0.	801.5	0.	0.	. .0	.0
2	13.5	0.	805.6	0.	0.	.0	.0
3	20.2	0.	808.8	0.	0.	.0	.0
4	25.1	0.	811.3	0.	0.	.0	.0
5	33.4	0.	815.7	0.	0.	.0	.0
6	42.5	0.	821.2	0.	0.	.0	.0
7	48.0	0.	824.8	0.	0.	.0	.0
8	49.4	0.	825.6	0.	0.	.0	.0
9	51.4	0.	826.6	0.	0.	.0	.0

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	15.0000	.7378E+04	-.5735E+07		
First-order corrections to F and THETA					-.380E+01	.354E+00
Values factored by .132E+00 - Deltas too large					-.500E+00	.466E-01
2	2.50000	15.0466	.6222E+04	-.4837E+07		

```
First-order corrections to F and THETA .........  -.226E+01  .422E+00
Values factored by  .221E+00 - Deltas too large   -.500E+00  .935E-01

   3   2.00000    15.1400   .4521E+04  -.3516E+07
First-order corrections to F and THETA .........  -.107E+01  .577E+00
Values factored by  .465E+00 - Deltas too large   -.500E+00  .269E+00

   4   1.50000    15.4087   .1766E+04  -.1378E+07
First-order corrections to F and THETA .........  -.244E+00  .133E+01
Second-order correction - Iteration   1 ........  -.215E+00  .133E+01
Second-order correction - Iteration   2 ........  -.214E+00  .133E+01
Second-order correction - Iteration   3 ........  -.214E+00  .133E+01

   5   1.28561    16.7402  -.3561E+02   .1741E+05
First-order corrections to F and THETA .........   .168E-01  .981E+01
Values factored by  .876E+00 - Deltas too large    .147E-01  .859E+01

   6   1.30034    25.3345  -.1078E+02   .8495E+04
First-order corrections to F and THETA .........   .201E-03 -.580E+00
Second-order correction - Iteration   1 ........   .210E-03 -.580E+00
Second-order correction - Iteration   2 ........   .210E-03 -.580E+00

   7   1.30055    24.7546   .1190E-02  -.3719E+02
First-order corrections to F and THETA .........   .413E-04  .278E-01
Second-order correction - Iteration   1 ........   .414E-04  .279E-01

   8   1.30059    24.7824   .1221E-03  -.2537E+00
First-order corrections to F and THETA .........   .176E-06  .126E-03

Factor of Safety - - - - - - - -      1.301
Side Force Inclination - - - - -      24.78
Number of Iterations - - - - - -      8
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:27:2004   Time: 10:32:43   Input file: GPEX1.dat
  Gluek Park Remediation
  Profile #1 - Existing Slope with Vegetation
  May 20, 2004

TABLE NO. 38
**********************************************************************
*  Final Results for Stresses Along the Shear Surface                *
*  (Results for Critical Shear Surface in Case of a Search.)         *
**********************************************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  1.301     Side Force Inclination =  24.78 Degrees

        -------- VALUES AT CENTER OF BASE OF SLICE---------

                                    Total     Effective
Slice                               Normal    Normal       Shear
  No.    X-center   Y-center        Stress    Stress       Stress

   1         4.2      800.8         194.4      194.4        191.5
   2        13.5      803.5         469.0      469.0        225.3
   3        20.2      805.8         612.5      612.5        294.3
   4        25.1      808.1         615.2      615.2        295.6
   5        33.4      812.6         549.5      549.5        234.2
   6        42.5      818.6         404.4      404.4        172.4
   7        48.0      822.8         286.3      286.3        122.0
   8        49.4      824.0         237.3      237.3        101.1
   9        51.4      825.8          74.0       74.0        144.3
```

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .307E-03)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .227E-03)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = .06 (= .577E-01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .275E-03)
SHOULD NOT EXCEED .100E+03

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:32:43 Input file: GPEX1.dat
Gluek Park Remediation
Profile #1 - Existing Slope with Vegetation
May 20, 2004

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.301 Side Force Inclination = 24.78 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	8.3	1336.	802.7	.313	-49.5	858.0
2	18.8	2108.	806.9	.290	-86.6	757.6
3	21.6	2235.	808.1	.277	-111.5	776.3
4	28.6	2260.	811.4	.239	-176.0	796.1
5	38.1	1320.	816.4	.174	-189.0	584.1
6	46.9	79.	817.7	BELOW	-137.2	171.3
7	49.1	-206.	825.1	.398	-21.1	-87.2
8	49.7	-281.	825.1	.260	37.4	-207.5
9	53.1	0.	827.4	.500	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .307E-03)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .227E-03)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = .06 (= .577E-01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .275E-03)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** FORCES BETWEEN SLICES ARE NEGATIVE AT POINTS ALONG THE UPPER ONE-HALF OF THE SHEAR SURFACE - A TENSION CRACK MAY BE NEEDED.

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS ABOVE THE SURFACE OF THE SLOPE OR BELOW THE SHEAR SURFACE - EITHER A TENSION CRACK MAY BE NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION.

END-OF-FILE ENCOUNTERED WHILE READING COMMAND

WORDS - END OF PROBLEM(S) ASSUMED

```
HEADING
  Gluek Park Remediation
  Profile #1 - Existing Slope w/o Vegetation
  May 20, 2004
PROFILE LINES
  1  1  Surface/Vegetated
  -10.00   799.00
    0.00   799.77
   21.58   812.64
   49.09   827.27
   71.01   828.01
  150.00   828.01

  2  2  Fill
    21.58  809.64
    49.09  824.27
    71.01  825.01
   150.00  828.01

  3  3  Top of Native Sand
  -50.00   799.00
    0.00   796.77
   21.58   809.64
  150.00   812.01

  4  4  Top of Native Clay
  -50.00   788.00
    0.00   788.00
  150.00   788.00


MATERIAL PROPERTIES
   1     VEGETATED SURFICAL SOILS
   115 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
    15    27
   NO PORE PRESSURE
   2     EXISTING FILL SOILS
   115 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
    0   29
   NO PORE PRESSUE
   3     NATIVE GRANULAR SOILS
   125 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   0    32
   PIEZOMETRIC LINE
    1
   4     NATIVE CLAY
   132 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   1000   0
   PIEZOMETRIC LINE
    1

   PIEZOMETERIC LINE DATA
   1    62.4   WATER TABLE
   -50  799
   150  799
```

```
ANALYSIS/COMPUTATIONS
   CIRCULAR   SEARCH
    50  855  2.0  0
    POINT
    0.00  799.77
    SUBTENDED
    6
    SHORT
    PROCEDURE
    SPENCER

COMPUTE
```

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat

TABLE NO. 1
```
*****************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.107                      *
* Last Revision Date 10/13/91            *
* (C) Copyright 1985-1991 S. G. Wright   *
* All Rights Reserved                    *
*****************************************
```

```
*****************************************************************
*                                                               *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER    *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY    *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL      *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE      *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER     *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS         *
* PROGRAM BEFORE ATTEMPTING ITS USE.                            *
*                                                               *
*      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT    *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR     *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS     *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                     *
*                                                               *
*****************************************************************
```

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 2
```
*************************
* NEW PROFILE LINE DATA *
*************************
```

PROFILE LINE 1 - MATERIAL TYPE = 1
Surface/Vegetated

Point	X	Y
1	-10.000	799.000
2	.000	799.770
3	21.580	812.640
4	49.090	827.270
5	71.010	828.010
6	150.000	828.010

PROFILE LINE 2 - MATERIAL TYPE = 2
Fill

Point	X	Y
1	21.580	809.640
2	49.090	824.270
3	71.010	825.010
4	150.000	828.010

PROFILE LINE 3 - MATERIAL TYPE = 3
Top of Native Sand

Point	X	Y
1	-50.000	799.000
2	.000	796.770
3	21.580	809.640
4	150.000	812.010

PROFILE LINE 4 - MATERIAL TYPE = 4
Top of Native Clay

Point	X	Y
1	-50.000	788.000
2	.000	788.000
3	150.000	788.000

All new profile lines defined - No old lines retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 3
****
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

DATA FOR MATERIAL TYPE 1
VEGETATED SURFICAL SOILS

Unit weight of material = 115.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 15.000
Friction angle - - - - - 27.000 degrees

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 2
EXISTING FILL SOILS

Unit weight of material = 115.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - .000
Friction angle - - - - - 29.000 degrees

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 3
NATIVE GRANULAR SOILS

Unit weight of material = 125.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - .000
Friction angle - - - - - 32.000 degrees

Pore water pressures defined by piezometric line

Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
NATIVE CLAY

Unit weight of material = 132.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 1000.000
Friction angle - - - - - - .000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y	
1 - Unit weight of water =		62.40		WATER TABLE
1	1	-50.000	799.000	WATER TABLE
1	2	150.000	799.000	WATER TABLE

All new piezometric lines defined - No old lines retained

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 50.000
Y = 855.000

Required accuracy for critical center (= minimum spacing between grid points) = 2.000

Critical shear surface not allowed to pass below Y = .000

For the initial mode of search
all circles pass through the point at -
X = .000

Y = 799.770

Maximum subtended angle to be used for subdivision of the circle into slices = 6.00 degrees

Short form of output will be used for search

Procedure used to compute the factor of safety: SPENCER

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination for Spencer's procedure) will be kept constant during search

Depth of crack = .000

Search will be continued to locate a more critical shear surface (if one exists) after the initial mode is complete

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-50.000	799.000
2	-10.000	799.000
3	.000	799.770
4	21.580	812.640
5	49.090	827.270
6	71.010	828.010

7 150.000 828.010

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 20

Mode	Center Coordinates of Critical Circle X	Y	Radius	1-Stage Factor of Safety	Side Force Inclin.
1 Fixed Point at X = .0 Y = 799.8	-10.000	845.000	46.322	1.079	28.54
2 Tangent Line at Y = 798.7	-10.000	845.000	46.322	1.079	28.54

TABLE NO. 21
***** 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center	-10.000
Y Coordinate of Center	845.000
Radius	46.322
Factor of Safety	1.079
Side Force Inclination	28.54
Number of circles tried	71
No. of circles F calc. for	38

***** CAUTION ***** FACTOR OF SAFETY COULD NOT BE COMPUTED FOR SOME OF GRID POINTS AROUND THE MINIMUM
***** RESULTS MAY BE ERRONEOUS *****

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 26

* Coordinate, Weight, Strength and Pore Water Pressure Information for Individual Slices for Conventional Computations or First Stage of Multi-Stage Computations. (Information is for the Critical Shear Surface in the Case of an Automatic Search.) *

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	.0	799.8					
1	.0	799.8	.0	1	15.00	27.00	.0
	.0	799.8					
2	2.3	800.4	401.4	1	15.00	27.00	.0
	4.7	801.1					
3	6.9	802.0	1013.0	1	15.00	27.00	.0
	9.2	802.8					

4	11.3	804.0	1274.1	1	15.00	27.00	.0
	13.5	805.1					
5	15.5	806.4	1213.6	1	15.00	27.00	.0
	17.5	807.7					
6	19.4	809.3	883.9	1	15.00	27.00	.0
	21.3	810.8					
7	21.4	811.0	55.3	1	15.00	27.00	.0
	21.6	811.1					
8	23.1	812.7	272.2	1	15.00	27.00	.0
	24.7	814.3					

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 27

Seismic Forces and Forces Due to Surface Pressures for Individual Slices for Conventional Computations or the First Stage of Multi-Stage Computations. (Information is for the Critical Shear Surface in the Case of an Automatic Search.)

Slice No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO SURFACE PRESSURES Normal Force	Shear Force	X	Y
1	.0	0.	799.8	0.	0.	.0	.0
2	2.3	0.	800.8	0.	0.	.0	.0
3	6.9	0.	802.9	0.	0.	.0	.0
4	11.3	0.	805.2	0.	0.	.0	.0
5	15.5	0.	807.7	0.	0.	.0	.0
6	19.4	0.	810.3	0.	0.	.0	.0
7	21.4	0.	811.8	0.	0.	.0	.0
8	23.1	0.	813.1	0.	0.	.0	.0

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 5:27:2004 Time: 10:44:40 Input file: GPEX1A.dat
Gluek Park Remediation
Profile #1 - Existing Slope w/o Vegetation
May 20, 2004

TABLE NO. 29

Information Generated During Iterative Solution for the Factor of Safety and Side Force Inclination by Spencer's Procedure

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	15.0000	.1648E+04	-.1277E+07		
First-order corrections to F and THETA					-.504E+01	.155E+00
Values factored by .991E-01 - Deltas too large					-.500E+00	.153E-01
2	2.50000	15.0153	.1453E+04	-.1127E+07		
First-order corrections to F and THETA					-.314E+01	.180E+00
Values factored by .159E+00 - Deltas too large					-.500E+00	.286E-01

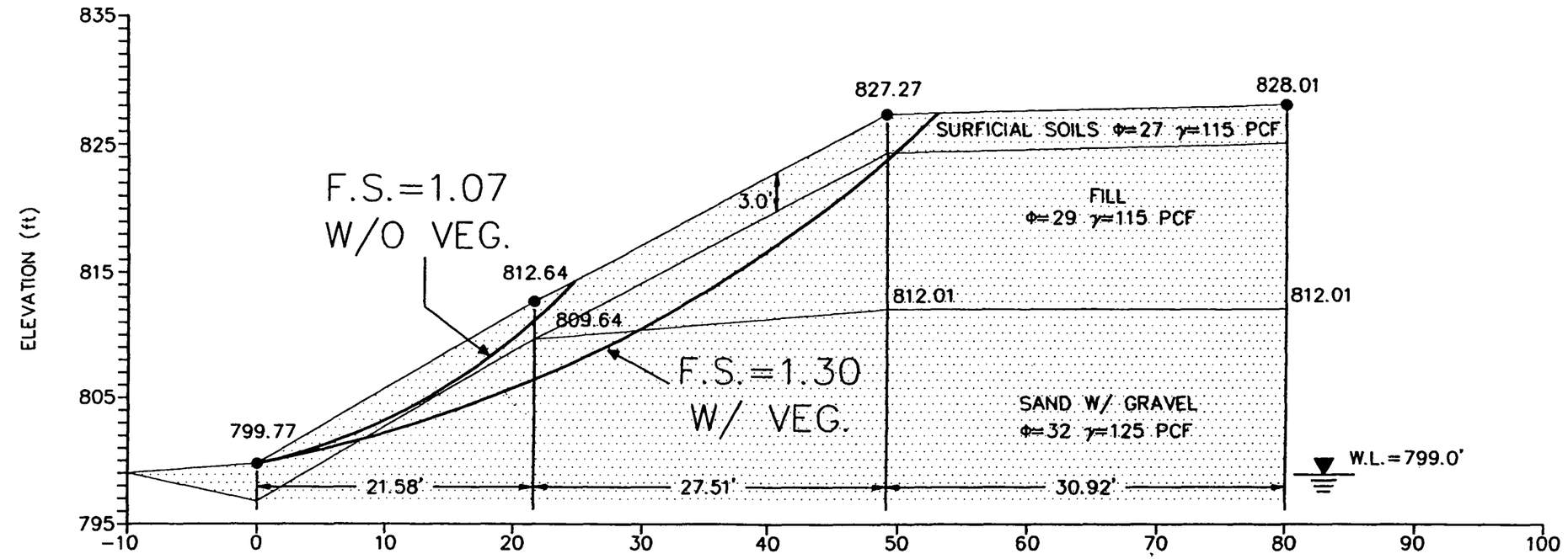
```
   3   2.00000     15.0439    .1168E+04  -.9059E+06
First-order corrections to F and THETA .........   -.166E+01   .230E+00
Values factored by  .301E+00 - Deltas too large    -.500E+00   .691E-01

   4   1.50000     15.1130    .7091E+03  -.5500E+06
First-order corrections to F and THETA .........   -.591E+00   .385E+00
Values factored by  .846E+00 - Deltas too large    -.500E+00   .326E+00

   5   1.00000     15.4387   -.1565E+03   .1199E+06
First-order corrections to F and THETA .........    .606E-01  -.200E+01
Second-order correction - Iteration   1 ........    .650E-01  -.200E+01
Second-order correction - Iteration   2 ........    .650E-01  -.200E+01

   6   1.06501     13.4391    .8731E+00  -.1921E+04
First-order corrections to F and THETA .........    .129E-01   .158E+02
Values factored by  .545E+00 - Deltas too large    .704E-02   .859E+01

   7   1.07206     22.0335   -.3642E+00  -.2936E+03
First-order corrections to F and THETA .........    .669E-02   .700E+01
Second-order correction - Iteration   1 ........    .700E-02   .700E+01
Second-order correction - Iteration   2 ........    .700E-02   .700E+01

   8   1.07906     29.0370   -.1474E+00   .1477E+03
First-order corrections to F and THETA .........   -.454E-03  -.492E+00
Second-order correction - Iteration   1 ........   -.451E-03  -.492E+00

   9   1.07860     28.5448    .2632E-03  -.4561E+00
First-order corrections to F and THETA .........    .298E-05   .298E-02

Factor of Safety - - - - - - - -      1.079
Side Force Inclination - - - - -      28.54
Number of Iterations - - - - - -      9
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:27:2004   Time: 10:44:40   Input file: GPEX1A.dat
  Gluek Park Remediation
  Profile #1 - Existing Slope w/o Vegetation
  May 20, 2004

TABLE NO. 38
**********************************************************************
*  Final Results for Stresses Along the Shear Surface                *
*  (Results for Critical Shear Surface in Case of a Search.)         *
**********************************************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  1.079     Side Force Inclination =  28.54 Degrees

        -------- VALUES AT CENTER OF BASE OF SLICE---------

                                    Total     Effective
Slice                               Normal    Normal       Shear
 No.    X-center   Y-center        Stress    Stress       Stress

   1         .0      799.8          10.2      10.2         18.7
   2        2.3      800.4          87.5      87.5         55.2
   3        6.9      802.0         198.3     198.3        107.6
   4       11.3      804.0         233.2     233.2        124.1
   5       15.5      806.4         210.9     210.9        113.5
   6       19.4      809.3         147.0     147.0         83.4
   7       21.4      811.0         104.8     104.8         63.4
   8       23.1      812.7          45.5      45.5         35.4
```

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =          .00  (=  .524E-04)
     SHOULD NOT EXCEED      .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =          .00  (=  .758E-04)
     SHOULD NOT EXCEED      .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =          .45  (=  .448E+00)
     SHOULD NOT EXCEED      .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =          .00  (=  .469E-04)
     SHOULD NOT EXCEED      .100E+03
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  5:27:2004   Time: 10:44:40   Input file: GPEX1A.dat
  Gluek Park Remediation
  Profile #1 - Existing Slope w/o Vegetation
  May 20, 2004

TABLE NO. 39
**********************************************************************
*  Final Results for Side Forces and Stresses Between Slices.  *
*  (Results for Critical Shear Surface in Case of a Search.)   *
**********************************************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  1.079     Side Force Inclination =  28.54 Degrees

        --------------- VALUES AT RIGHT SIDE OF SLICE ----------------

                                  Y-Coord. of   Fraction    Sigma      Sigma
Slice                    Side     Side Force      of         at         at
  No.     X-Right        Force    Location      Height      Top       Bottom

   1          .0           0.       799.8      .000          .0         .0
   2         4.7         165.       801.7      .418         49.3      144.8
   3         9.2         317.       803.7      .349         11.1      220.0
   4        13.5         331.       806.0      .332         -1.1      213.4
   5        17.5         212.       808.6      .328         -2.5      152.7
   6        21.3          51.       811.5      .414         13.4       41.9
   7        21.6          40.       811.8      .499         23.5       23.7
   8        24.7           0.      2160.7    ABOVE-10000000.010000000.0


CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =          .00  (=  .524E-04)
     SHOULD NOT EXCEED      .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =          .00  (=  .758E-04)
     SHOULD NOT EXCEED      .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =          .45  (=  .448E+00)
     SHOULD NOT EXCEED      .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =          .00  (=  .469E-04)
     SHOULD NOT EXCEED      .100E+03


END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

APPENDIX B

Slope Stability Analyses – Existing Conditions

B-3 Graphic Presentation of Results



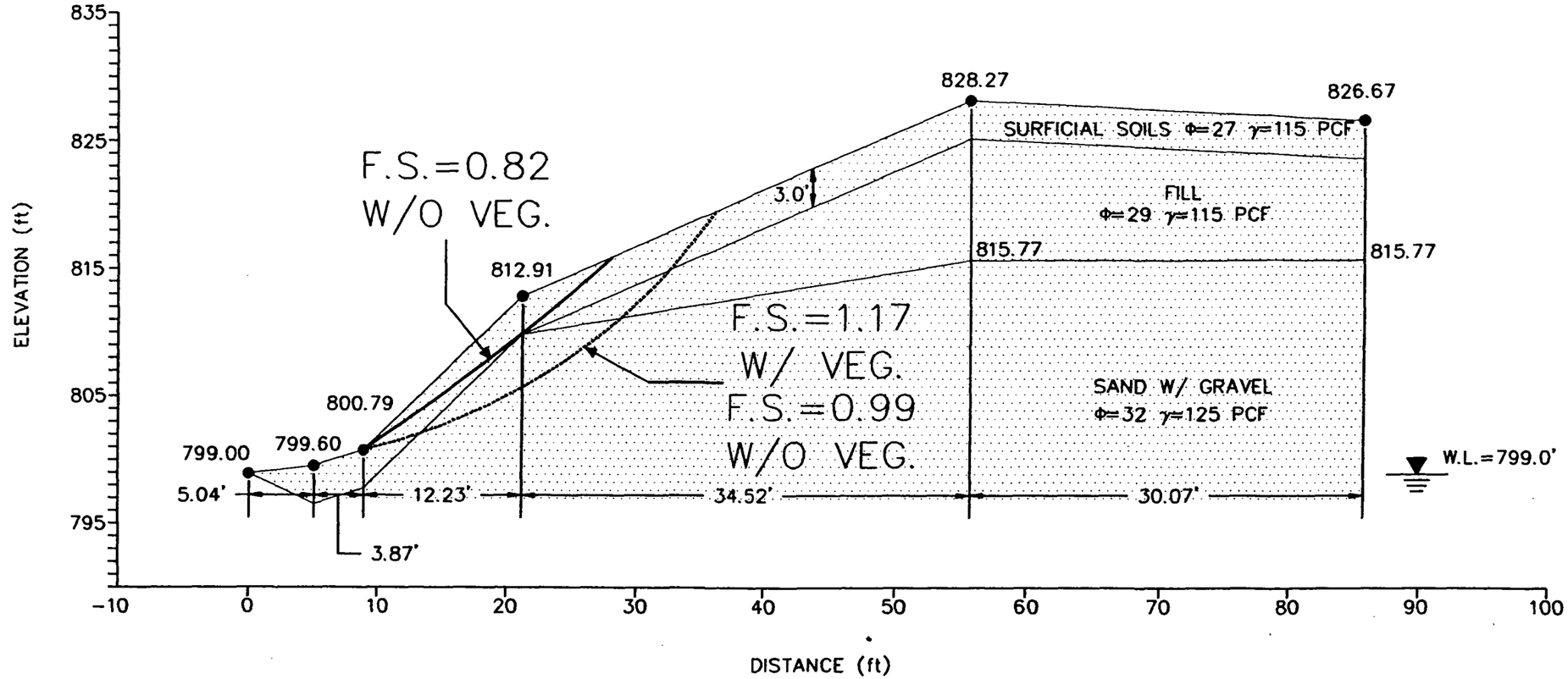
NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB1
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

HORIZ. 0" 5" 10"
VERT. 0" 5" 10"

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 1
(LOOKING NORTH)

05/19/04 73040



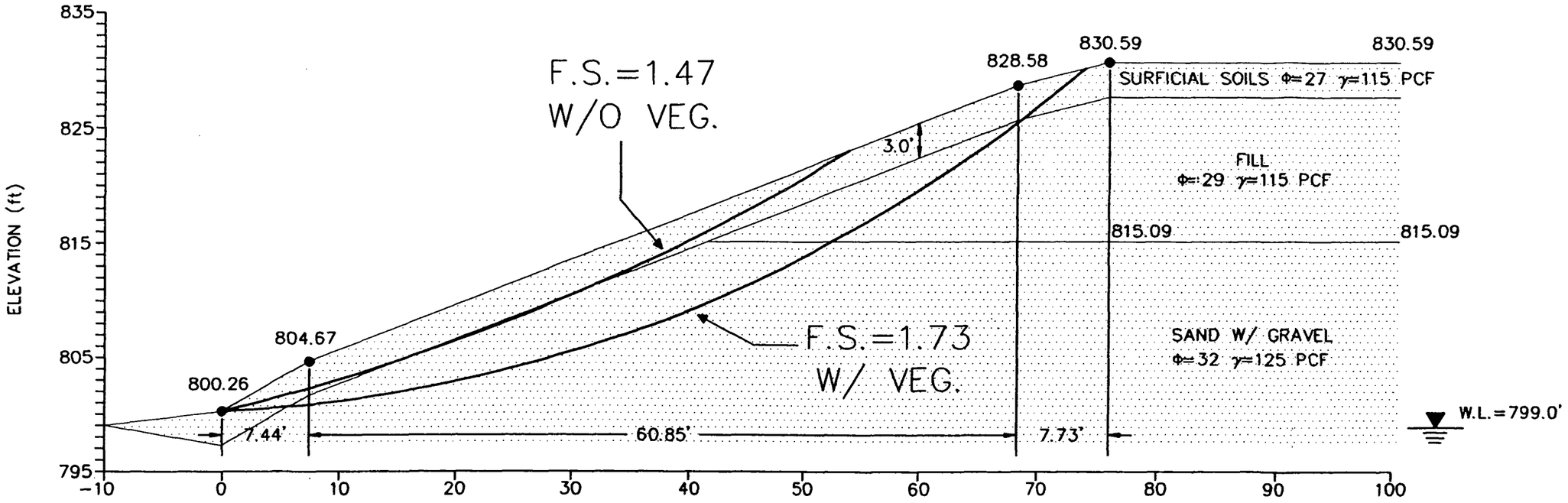
NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB2
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 2
(LOOKING NORTH)

05/19/04 73040



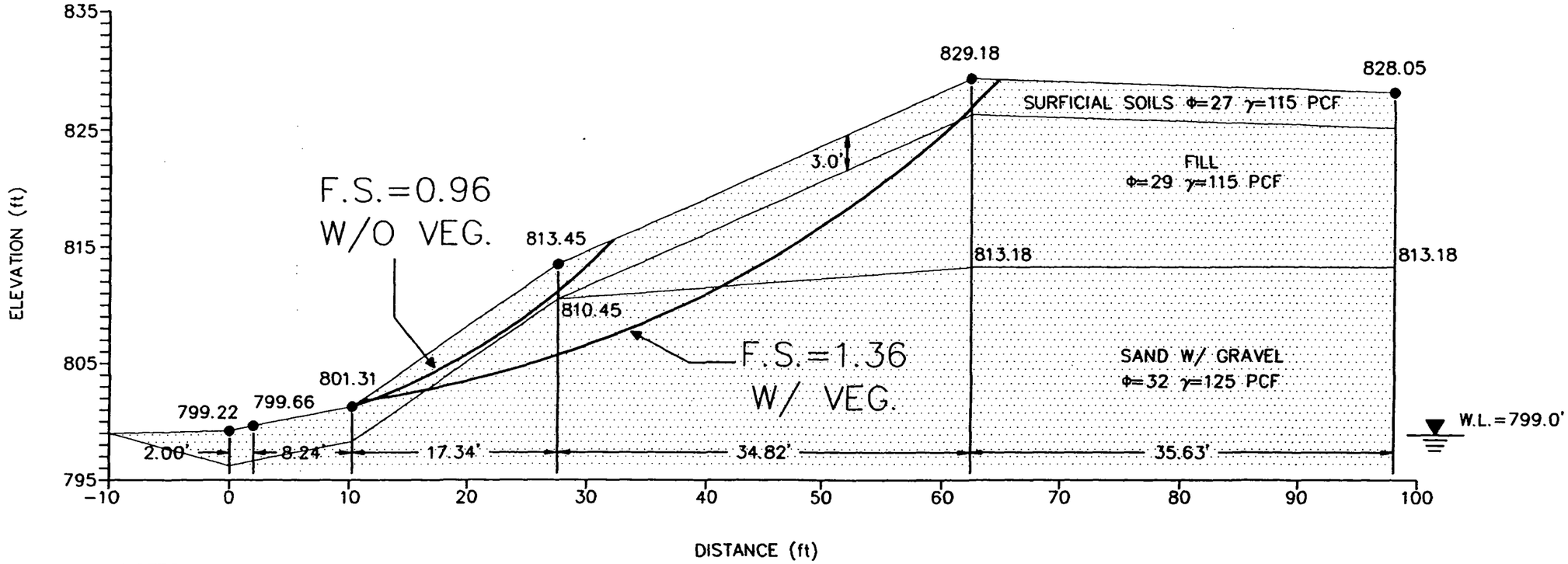
NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB3
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 3
(LOOKING NORTH)

05/19/04 73040



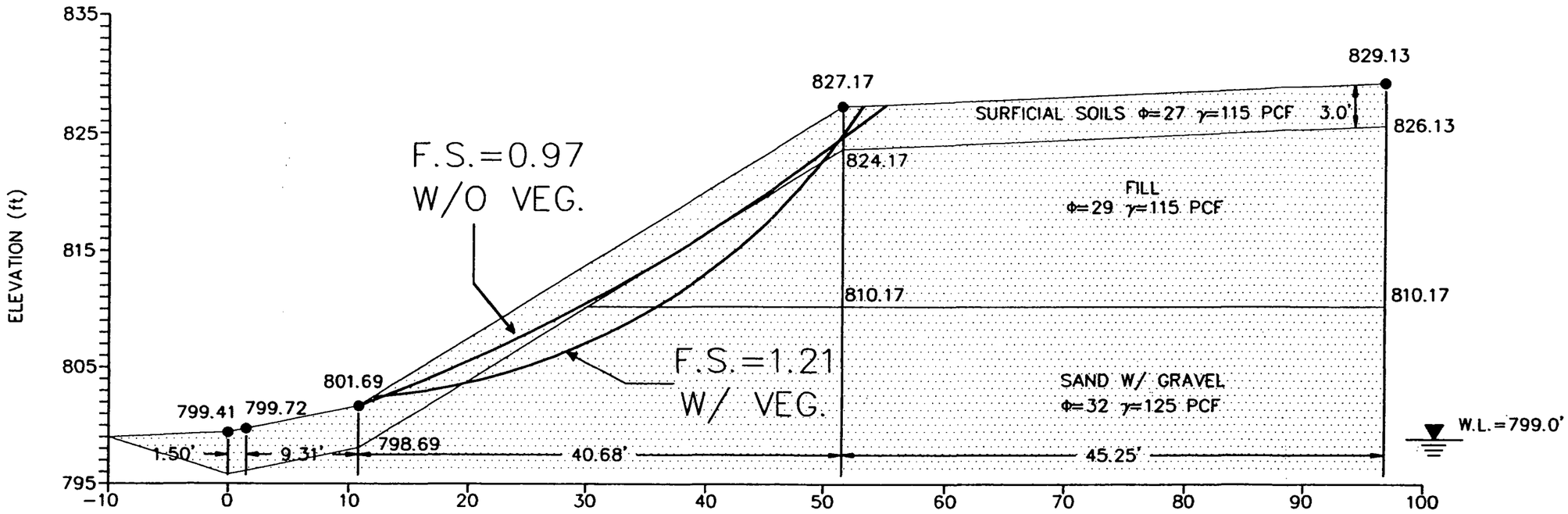
NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB4
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 4
(LOOKING NORTH)

05/19/04 73040



NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB5
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

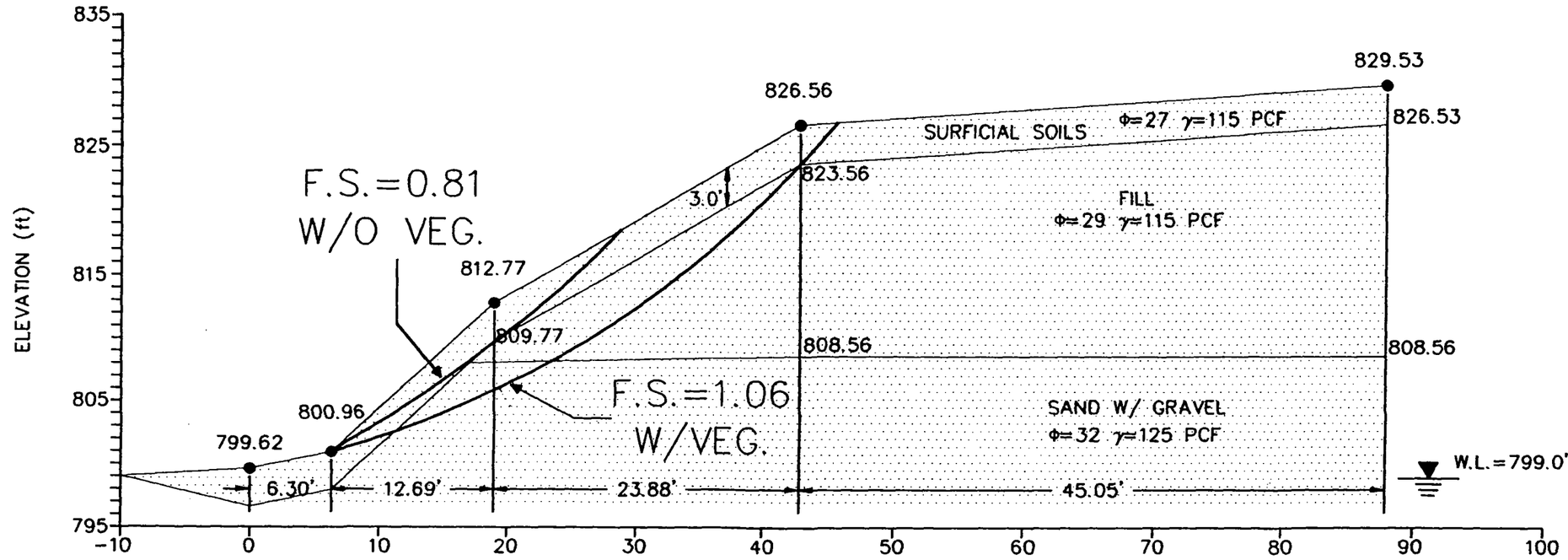
HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 5
(LOOKING NORTH)

05/19/04

73040



NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB6
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

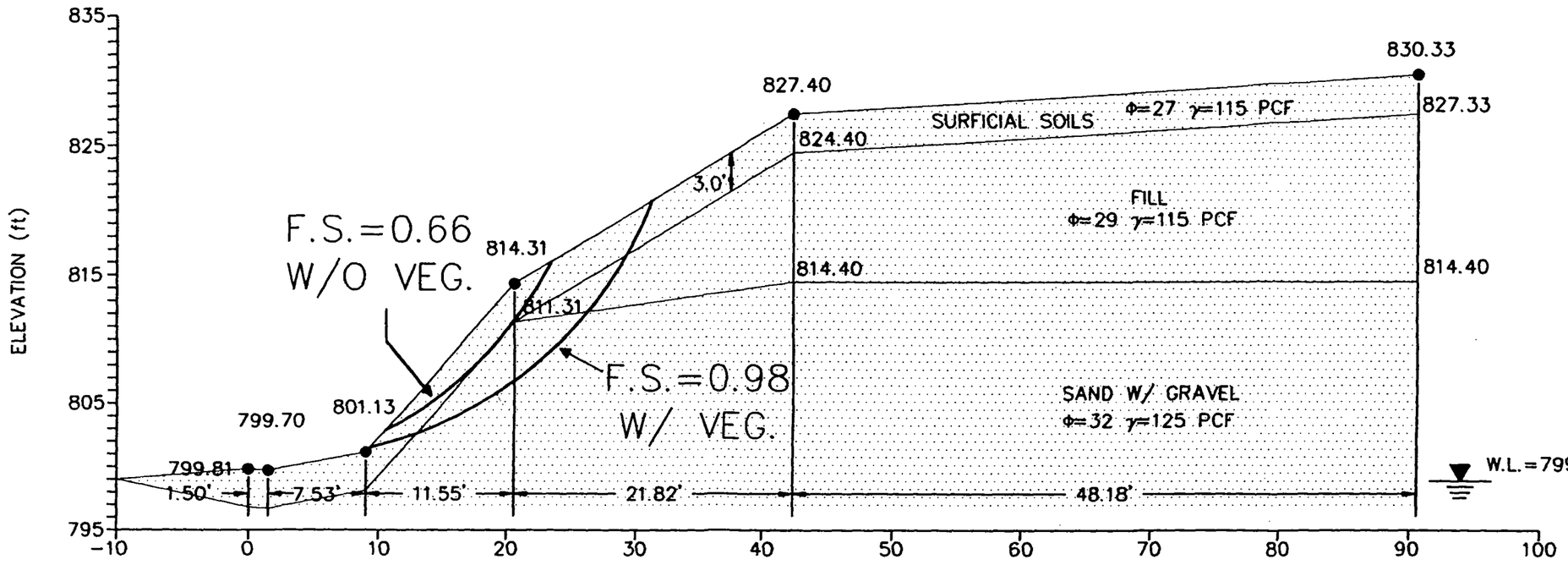
HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 6
(LOOKING NORTH)

05/19/04

73040



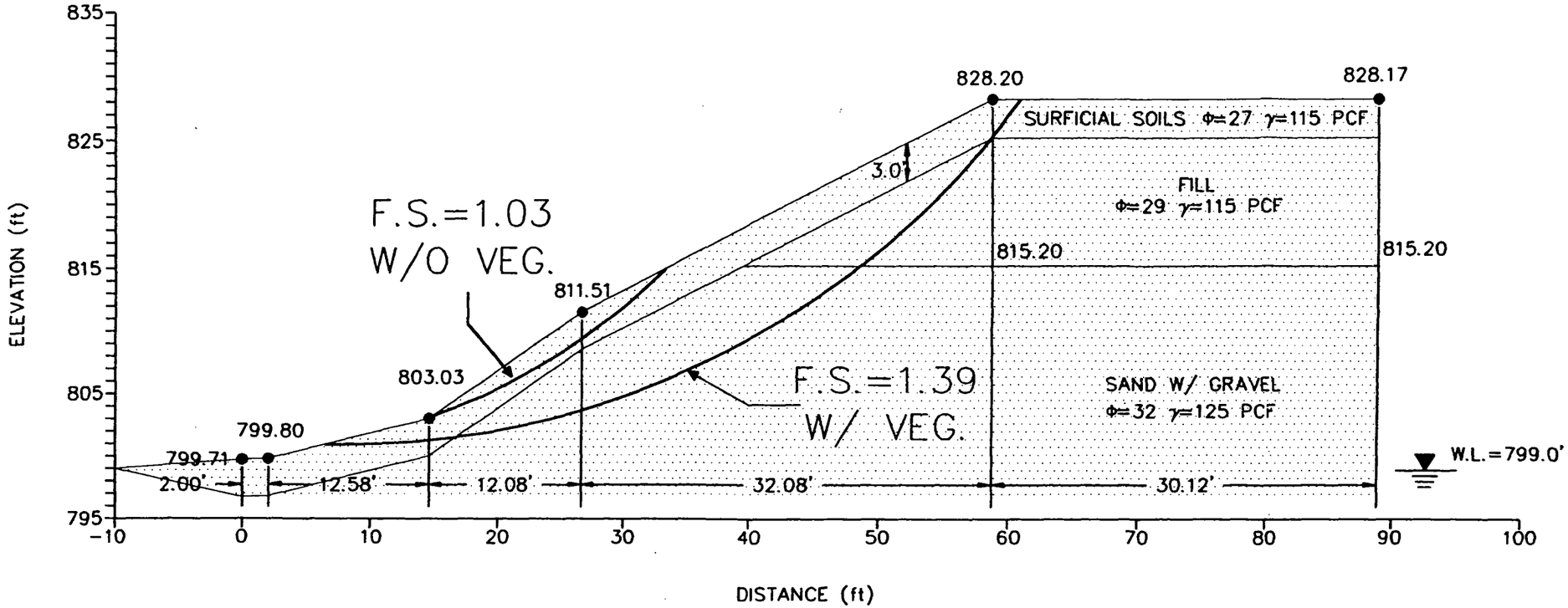
NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB7
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 7
(LOOKING NORTH)

05/19/04 73040



NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB8
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

HORIZ. 0' 5' 10'
VERT. 0' 5' 10'

EARTH TECH

GLUEK PARK
EXISTING BANK PROFILE NO. 8
(LOOKING NORTH)

05/19/04

73040

APPENDIX C

Slope Stability Analyses – Reconfigurations

C-1 Typical Data File

C-2 Typical Output File

C-3 Graphic Presentation of Results

APPENDIX C

Slope Stability Analyses – Reconfigurations

C-1 Typical Data File

```
HEADING
  Gluek Park Remediation
  Profile #7 - Reconfiguration Option C
  May 28, 2004
PROFILE LINES
  1  1  Rip Rap
    1.50   799.70
   16.50   811.70

  2  2  Surficial Soils
   16.50   811.70
   55.50   828.19
   90.90   830.33
  150.00   830.33

  3  3  Fill
    29.75  814.40
    55.50  826.19
    90.90  828.33
   150.00  828.33

  4  4  Sand w/Gravel
  -50.00   799.00
  -10.00   799.00
    0.00   796.81
    1.50   796.70
    9.03   799.13
   16.50   809.70
   55.50   814.40
   90.90   814.40
  150.00   814.40

  5  5  Top of Native Clay
  -50.00   788.00
    0.00   788.00
  150.00   788.00


MATERIAL PROPERTIES
   1      RIP RAP
   138 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   0     45
   NO PORE PRESSURE
   2      VEGETATED SURFICAL SOILS
   115 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   75    27
   NO PORE PRESSURE
   3      EXISTING FILL SOILS
   115 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
    0    29
   NO PORE PRESSUE
   4      SAND with GRAVEL
   125 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   0     32
   PIEZOMETRIC LINE
    1
   5      NATIVE CLAY
```

```
   132 = UNIT WEIGHT
   CONVENTIONAL SHEAR STRENGTH
   1000   0
   PIEZOMETRIC LINE
    1

   PIEZOMETERIC LINE DATA
   1    62.4   WATER TABLE
   -50  799
   150  799


ANALYSIS/COMPUTATIONS
   CIRCULAR   SEARCH
    1.50  860  2.0  0
    POINT
    1.50  799.70
    SUBTENDED
    6
    SHORT
    PROCEDURE
    SPENCER

COMPUTE
```

APPENDIX C

Slope Stability Analyses – Reconfigurations

C-2 Typical Output File

```
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
        Date:  6: 2:2004   Time: 12:28:51   Input file: GP7OPC.dat


        TABLE NO. 1
        ******************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.107                      *
        * Last Revision Date 10/13/91            *
        * (C) Copyright 1985-1991 S. G. Wright   *
        * All Rights Reserved                    *
        ******************************************

        ************************************************************************
        *                                                                      *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER           *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY           *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL             *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE             *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER            *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS                *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                                   *
        *                                                                      *
        *      NEITHER THE UNIVERSITY OF TEXAS NOR STEPHEN G. WRIGHT           *
        * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR            *
        * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS            *
        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                            *
        *                                                                      *
        ************************************************************************
1       UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
        Date:  6: 2:2004   Time: 12:28:51   Input file: GP7OPC.dat
          Gluek Park Remediation
          Profile #7 - Reconfiguration Option C
          May 28, 2004

        TABLE NO.  2
        *************************
        * NEW PROFILE LINE DATA *
        *************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Rip Rap

             Point       X              Y

               1          1.500        799.700
               2         16.500        811.700

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Surficial Soils

             Point       X              Y

               1         16.500        811.700
               2         55.500        828.190
               3         90.900        830.330
               4        150.000        830.330

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Fill

             Point       X              Y
```

1	29.750	814.400
2	55.500	826.190
3	90.900	828.330
4	150.000	828.330

PROFILE LINE 4 - MATERIAL TYPE = 4
Sand w/Gravel

Point	X	Y
1	-50.000	799.000
2	-10.000	799.000
3	.000	796.810
4	1.500	796.700
5	9.030	799.130
6	16.500	809.700
7	55.500	814.400
8	90.900	814.400
9	150.000	814.400

PROFILE LINE 5 - MATERIAL TYPE = 5
Top of Native Clay

Point	X	Y
1	-50.000	788.000
2	.000	788.000
3	150.000	788.000

All new profile lines defined - No old lines retained
1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 3
****
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

DATA FOR MATERIAL TYPE 1
RIP RAP

Unit weight of material = 138.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - .000
Friction angle - - - - - 45.000 degrees

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 2
VEGETATED SURFICAL SOILS

Unit weight of material = 115.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 75.000
Friction angle - - - - - 27.000 degrees

No (or zero) pore water pressures

```
DATA FOR MATERIAL TYPE  3
EXISTING FILL SOILS

     Unit weight of material =  115.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - - -         .000
     Friction angle - - - - -  29.000 degrees

     No (or zero) pore water pressures

DATA FOR MATERIAL TYPE  4
SAND with GRAVEL

     Unit weight of material =  125.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - - -         .000
     Friction angle - - - - -  32.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  5
NATIVE CLAY

     Unit weight of material =  132.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - - -    1000.000
     Friction angle - - - - -     .000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  6: 2:2004   Time: 12:28:51   Input file: GP7OPC.dat
  Gluek Park Remediation
  Profile #7 - Reconfiguration Option C
  May 28, 2004

TABLE NO.  5
**************************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************

Line
 No.    Point       X           Y

  1 - Unit weight of water =   62.40   WATER TABLE
  1        1     -50.000     799.000   WATER TABLE
  1        2     150.000     799.000   WATER TABLE

All new piezometric lines defined - No old lines retained
1    UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date:  6: 2:2004   Time: 12:28:51   Input file: GP7OPC.dat
  Gluek Park Remediation
  Profile #7 - Reconfiguration Option C
  May 28, 2004
```

TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Automatic Search Performed

Starting Center Coordinate for Search at -
X = 1.500
Y = 860.000

Required accuracy for critical center (= minimum spacing between grid points) = 2.000

Critical shear surface not allowed to pass below Y = .000

For the initial mode of search
all circles pass through the point at -
X = 1.500
Y = 799.700

Maximum subtended angle to be used for subdivision of the circle into slices = 6.00 degrees

Short form of output will be used for search

Procedure used to compute the factor of safety: SPENCER

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Initial trial values for factor of safety (and side force inclination for Spencer's procedure) will be kept constant during search

Depth of crack = .000

Search will be continued to locate a more critical shear surface (if one exists) after the initial mode is complete

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-50.000	799.000
2	-10.000	799.000
3	.000	796.810
4	1.500	796.700
5	1.500	799.700
6	16.500	811.700
7	55.500	828.190
8	90.900	830.330
9	150.000	830.330

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 20
****
* SHORT-FORM TABLE FOR SEARCH WITH CIRCULAR SHEAR SURFACES *
****

Mode	Center Coordinates of Critical Circle X	Y	Radius	1-Stage Factor of Safety	Side Force Inclin.
1 Fixed Point at X = 1.5 Y = 799.7	-62.500	998.000	208.372	1.356	25.37
2 Tangent Line at Y = 789.6	-62.500	998.000	208.372	1.356	25.37

TABLE NO. 21
***** 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *****

X Coordinate of Center	-62.500
Y Coordinate of Center	998.000
Radius	208.372
Factor of Safety	1.356
Side Force Inclination	25.37

Number of circles tried - - - - - - - 90
No. of circles F calc. for - - - - - - 74

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 26

```
**********************************************************************
*  Coordinate, Weight, Strength and Pore Water Pressure              *
*  Information for Individual Slices for Conventional               *
*  Computations or First Stage of Multi-Stage Computations.         *
*  (Information is for the Critical Shear Surface in the            *
*  Case of an Automatic Search.)                                    *
**********************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	1.5	799.7					
1	5.3	801.0	1784.1	1	.00	45.00	.0
	9.0	802.3					
2	10.5	802.9	1709.9	1	.00	45.00	.0
	12.1	803.4					
3	14.3	804.3	3308.8	4	.00	32.00	.0
	16.5	805.2					
4	23.1	808.2	9951.2	4	.00	32.00	.0
	29.8	811.2					
5	29.9	811.3	255.8	4	.00	32.00	.0
	30.1	811.3					
6	39.6	816.7	10449.0	3	.00	29.00	.0
	49.1	822.0					
7	52.2	824.0	1907.9	3	.00	29.00	.0
	55.2	826.1					
8	55.3	826.2	68.9	2	75.00	27.00	.0
	55.5	826.3					
9	57.0	827.3	335.1	2	75.00	27.00	.0
	58.5	828.4					

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 27

```
**********************************************************************
*  Seismic Forces and Forces Due to Surface Pressures for           *
*  Individual Slices for Conventional  Computations or the          *
*  First Stage of Multi-Stage Computations.                         *
*  (Information is for the Critical Shear Surface in the            *
*  Case of an Automatic Search.)                                    *
**********************************************************************
```

				FORCES DUE TO SURFACE PRESSURES			
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	5.3	0.	801.9	0.	0.	.0	.0
2	10.5	0.	804.9	0.	0.	.0	.0
3	14.3	0.	807.2	0.	0.	.0	.0
4	23.1	0.	811.3	0.	0.	.0	.0
5	29.9	0.	814.3	0.	0.	.0	.0
6	39.6	0.	819.1	0.	0.	.0	.0
7	52.2	0.	825.4	0.	0.	.0	.0
8	55.3	0.	827.1	0.	0.	.0	.0
9	57.0	0.	827.8	0.	0.	.0	.0

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation

TABLE NO. 29

```
**************************************************************************
*  Information Generated During Iterative Solution for the Factor  *
*  of Safety and Side Force Inclination by Spencer's Procedure     *
**************************************************************************
```

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	15.0000	.7093E+04	-.5513E+07		
First-order corrections to F and THETA					-.355E+01	.311E+00
Values factored by .141E+00 - Deltas too large					-.500E+00	.438E-01
2	2.50000	15.0438	.5902E+04	-.4588E+07		
First-order corrections to F and THETA					-.208E+01	.373E+00
Values factored by .240E+00 - Deltas too large					-.500E+00	.895E-01
3	2.00000	15.1334	.4148E+04	-.3226E+07		
First-order corrections to F and THETA					-.956E+00	.521E+00
Values factored by .523E+00 - Deltas too large					-.500E+00	.272E+00
4	1.50000	15.4057	.1305E+04	-.1020E+07		
First-order corrections to F and THETA					-.174E+00	.146E+01
Second-order correction - Iteration 1					-.158E+00	.146E+01
Second-order correction - Iteration 2					-.158E+00	.146E+01
5	1.34231	16.8625	-.1545E+02	.3842E+04		
First-order corrections to F and THETA					.144E-01	.994E+01
Values factored by .864E+00 - Deltas too large					.125E-01	.859E+01
6	1.35478	25.4569	-.1114E+02	.8107E+04		
First-order corrections to F and THETA					.101E-02	-.889E-01
Second-order correction - Iteration 1					.101E-02	-.890E-01
7	1.35579	25.3679	.3052E-04	-.6359E+01		
First-order corrections to F and THETA					.945E-05	.622E-02
Second-order correction - Iteration 1					.930E-05	.611E-02
8	1.35580	25.3740	.1373E-03	-.3584E+00		
First-order corrections to F and THETA					.373E-06	.254E-03

Factor of Safety - - - - - - - - 1.356
Side Force Inclination - - - - - 25.37
Number of Iterations - - - - - - 8

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 38

```
**************************************************************
*  Final Results for Stresses Along the Shear Surface        *
*  (Results for Critical Shear Surface in Case of a Search.) *
**************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.356 Side Force Inclination = 25.37 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	5.3	801.0	222.0	222.0	163.8
2	10.5	802.9	510.1	510.1	376.2
3	14.3	804.3	647.8	647.8	298.6
4	23.1	808.2	624.2	624.2	287.7
5	29.9	811.3	566.9	566.9	261.3
6	39.6	816.7	421.8	421.8	172.5
7	52.2	824.0	226.1	226.1	92.4
8	55.3	826.2	153.0	153.0	112.8
9	57.0	827.3	69.5	69.5	81.4

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .864E-03)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .484E-03)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = .15 (= .147E+00)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .449E-03)
SHOULD NOT EXCEED .100E+03

1 UTEXAS3 - VER. 1.107 - 10/13/91 - (C) 1985-1991 S. G. WRIGHT
Date: 6: 2:2004 Time: 12:28:51 Input file: GP7OPC.dat
Gluek Park Remediation
Profile #7 - Reconfiguration Option C
May 28, 2004

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.356 Side Force Inclination = 25.37 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	9.0	728.	802.8	.143	-219.0	602.3
2	12.1	1351.	803.9	.105	-353.3	869.9
3	16.5	1556.	805.9	.143	-304.3	838.3
4	29.8	1646.	812.2	.165	-244.7	729.0
5	30.1	1638.	812.4	.165	-244.2	728.3
6	49.1	269.	822.2	.047	-121.1	261.9
7	55.2	-112.	826.4	.198	40.9	-141.6
8	55.5	-109.	826.6	.207	45.2	-164.6
9	58.5	0.	1884.9	ABOVE-10000000.0	10000000.0	

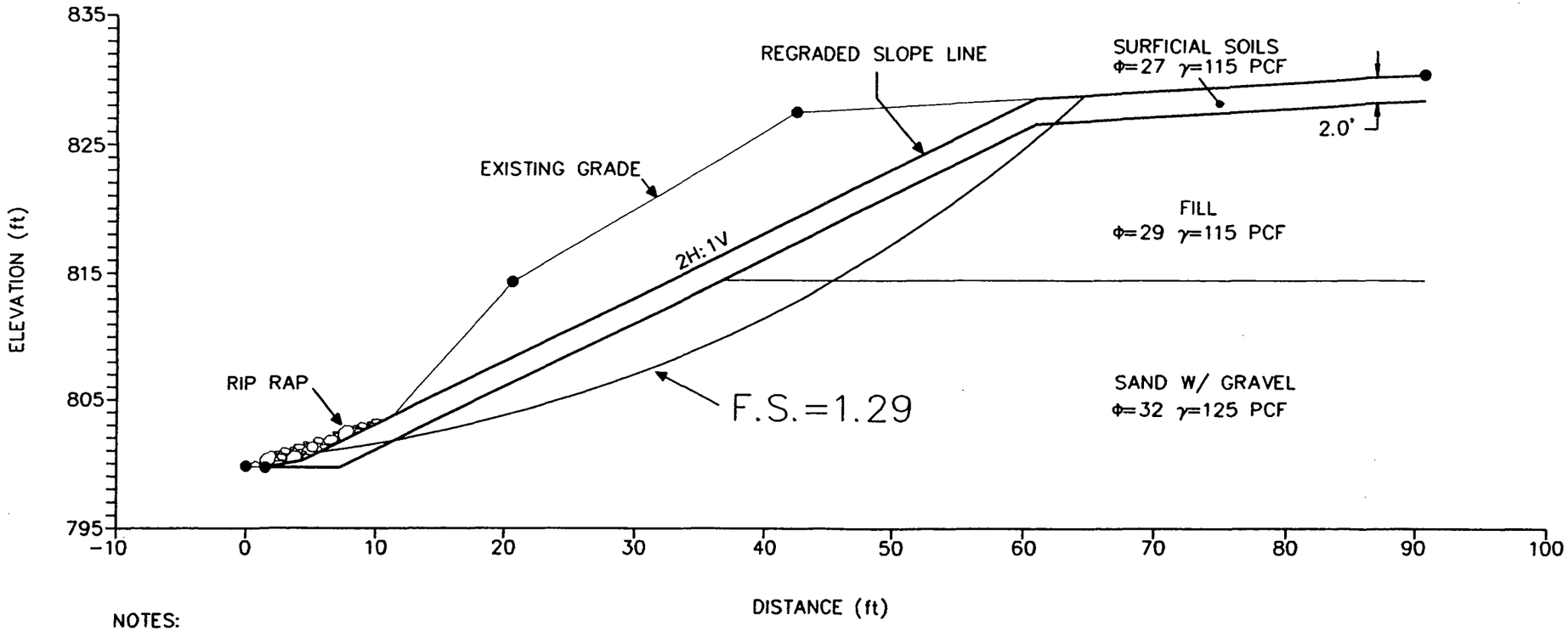
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .864E-03)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .484E-03)

```
     SHOULD NOT EXCEED      .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =          .15   (=   .147E+00)
     SHOULD NOT EXCEED      .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM    =         .00   (=   .449E-03)
     SHOULD NOT EXCEED      .100E+03



END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```

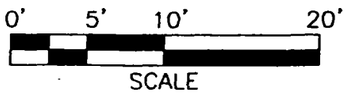
APPENDIX C

Slope Stability Analyses – Reconfigurations

C-3 Graphic Presentation of Results



NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB7
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

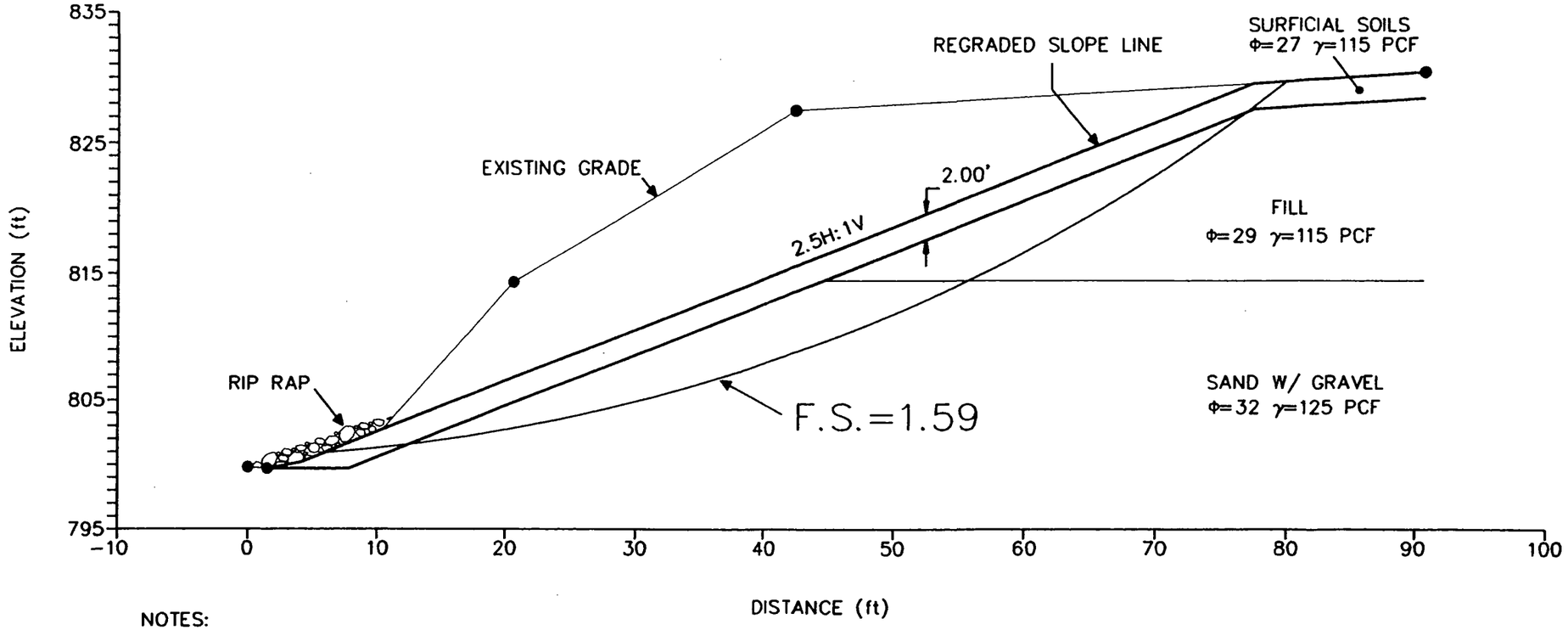


EARTH TECH

RECONFIGURATION – OPTION A
GLUEK PARK
BANK PROFILE NO. 7
(LOOKING NORTH)

05/19/04

73040



NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB7
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

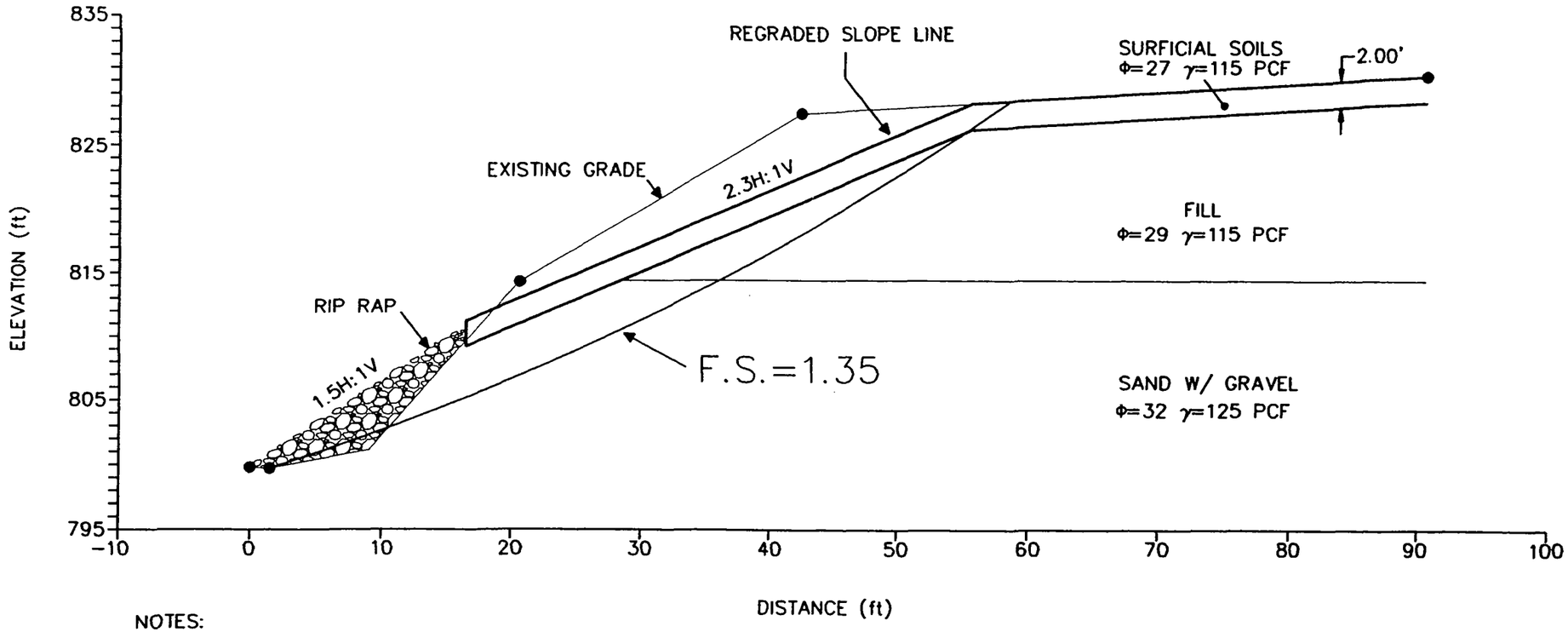
0' 5' 10' 20'
SCALE

EARTH TECH

RECONFIGURATION – OPTION B
GLUEK PARK
BANK PROFILE NO. 7
(LOOKING NORTH)

05/19/04

73040



NOTES:
1. SOIL PROFILE BASED ON SOIL BORING SB7
2. FRICTION ANGLE (Φ) AND UNIT WEIGHT (γ) ESTIMATED BASED ON SOIL TYPE AND FIELD TESTING

0' 5' 10' 20'
SCALE

EARTH TECH

RECONFIGURATION – OPTION C
GLUEK PARK
BANK PROFILE NO. 7
(LOOKING NORTH)

05/19/04

73040